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IMMEDIATE POLLUTION CONTROL NEEDS IN ALASKA

Federal Water Pollution Control Administration
College, Alaska

April 1967

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IMMEDIATE POLLUTION CONTROL NEEDS IN ALASKA

APRIL 1967

Barrow
ai
Kodiak
Sitka
au
Wrangell
chikan

March 3, 1849

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U.S. Department of the Interior
Federal Water Pollution Control Administration
Northwest Region

ALASKA WATER LABORATORY

COLLEGE, ALASKA

U. S. DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

NORTHWEST REGION

A Report of

IMMEDIATE POLLUTION CONTROL NEEDS IN ALASKA

APRIL 1967

Additional copies of this report may be obtained from

Alaska Water Laboratory
College, Alaska

INDEX

Page
Frontispiece.................................... i

Index... ii

Map of Alaska................................... iii

Foreward.. iv

Area Reports

Anchorage Metropolitan Area..................... 1.1

Fairbanks Area.................................. 2.1

Juneau-Douglas Area............................. 3.1

Kenai-Soldotna Area............................. 4.1

Ketchikan Area.................................. 5.1

Kodiak Area..................................... 6.1

Sitka Borough Area.............................. 7.1

Special Problems

Alaska-Wide Seafood Processing Wastes........... 8.1

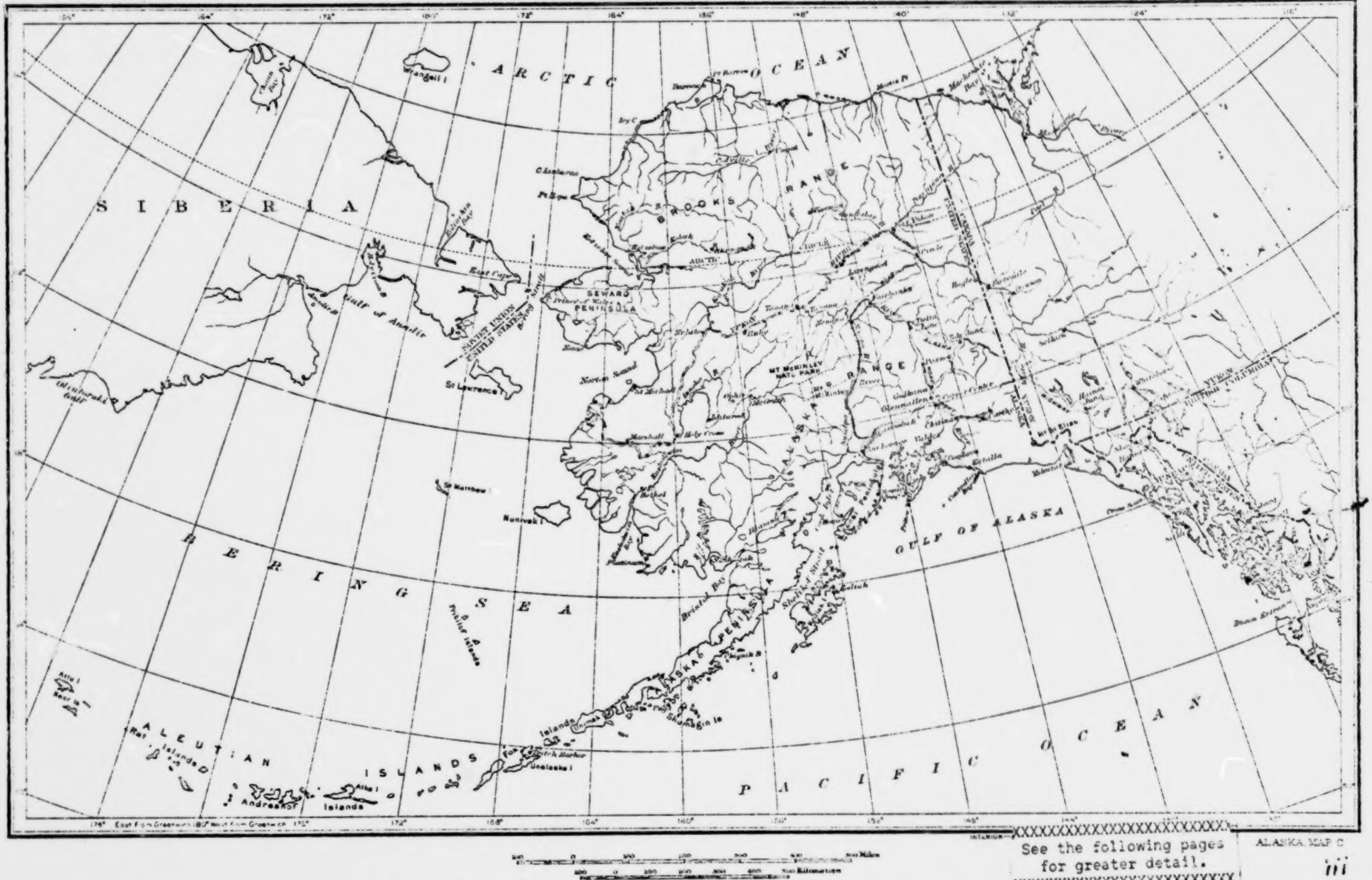
Statewide Forest and Mining Industry............ 9.1

Oil Industry.................................... 10.1

Remote Villages and Federal Installations.......11.1

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

ALASKA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BROOKS RANGE
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UNITED STATES
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St Lawrence I
Nunivak I
St Matthew I
Pribilof Islands
Norton Sound
Bristol Bay
Shelikof Strait
Kodiak
Shumagin Is
Unimak I
Unalaska I
Dutch Harbor
Fox Islands
Andreanof Islands
Rat Islands
Attu I
MT McKINLEY NAT'L PARK
Mt McKinley
Fairbanks
Anchorage
Valdez
Nome
Barrow
Pt Barrow
Pt Hope
C Lisburne
East Cape
YUKON
BRITISH COLUMBIA
CANADA
East from Greenwich 180° West from Greenwich

ALASKA MAP C

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See the following pages
for greater detail.
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FOREWARD

The purpose of this report is to summarize the immediate, known pollution control needs of Alaska. It is the first step in a comprehensive program to clarify the relationship of wastes disposal to the economy and environment of Alaska. The information presented has been obtained from existing files and documents in addition to interviews with public officials and others with direct knowledge of pollution conditions. No new water quality surveys were carried out for purposes of this report. Much of the information contained, although subjective in approach, represents first hand observations, or the results of interviews with persons with first hand knowledge.

Waste disposal has only recently begun to be generally recognized in Alaska as an agent causing environmental change; therefore, some potential problems may have been overlooked. Many smaller communities have had no pollution surveys whatever, although they are listed for future planning by an information bulletin[1] released by the State Department of Health and Welfare. The present report will group all such communities under a single heading for cost estimating.

This report was prepared under authority of the Federal Water Pollution Control Act, Section 3(a), as amended.

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[1] State of Alaska Department of Health & Welfare, "Proposed Standards for Water Pollution Control in the State of Alaska", March 1967.

SUMMARY OF PROBLEMS AND COSTS THROUGHOUT ALASKA

A. Municipal Waste Treatment

1. Primary and secondary treatment plant construction provisions for interceptors and connections, and extension of outfall lines	$58,600,000

Of this figure an estimated 25 percent is presently at the stage where some engineering planning exists. No projects are known to be under active construction.

B. Oil Pollution Control in Southwestern Alaska

1. Research of control measures	$ 200,000
2. Oil well drilling and crude handling	7,000,000
3. Preventive measures	400,000

C. Fisheries Industry Waste Treatment

1. Waste Disposal	$ 5,000,000
2. Waste Conversion to by-products	
a. Research	100,000
b. Plants and Equipment	5,000,000

D. Wood Products

1. Pulp Mill Effluent Treatment	$ 4,000,000
2. Sawdust and Scrap Disposal	50,000

E. Mining and Gravel Washing Industries

1. Gold Placer Mining	$ 114,000
2. Gravel Washing	2,000,000
TOTAL	$82,464,000

Problem Areas and Immediate Needs

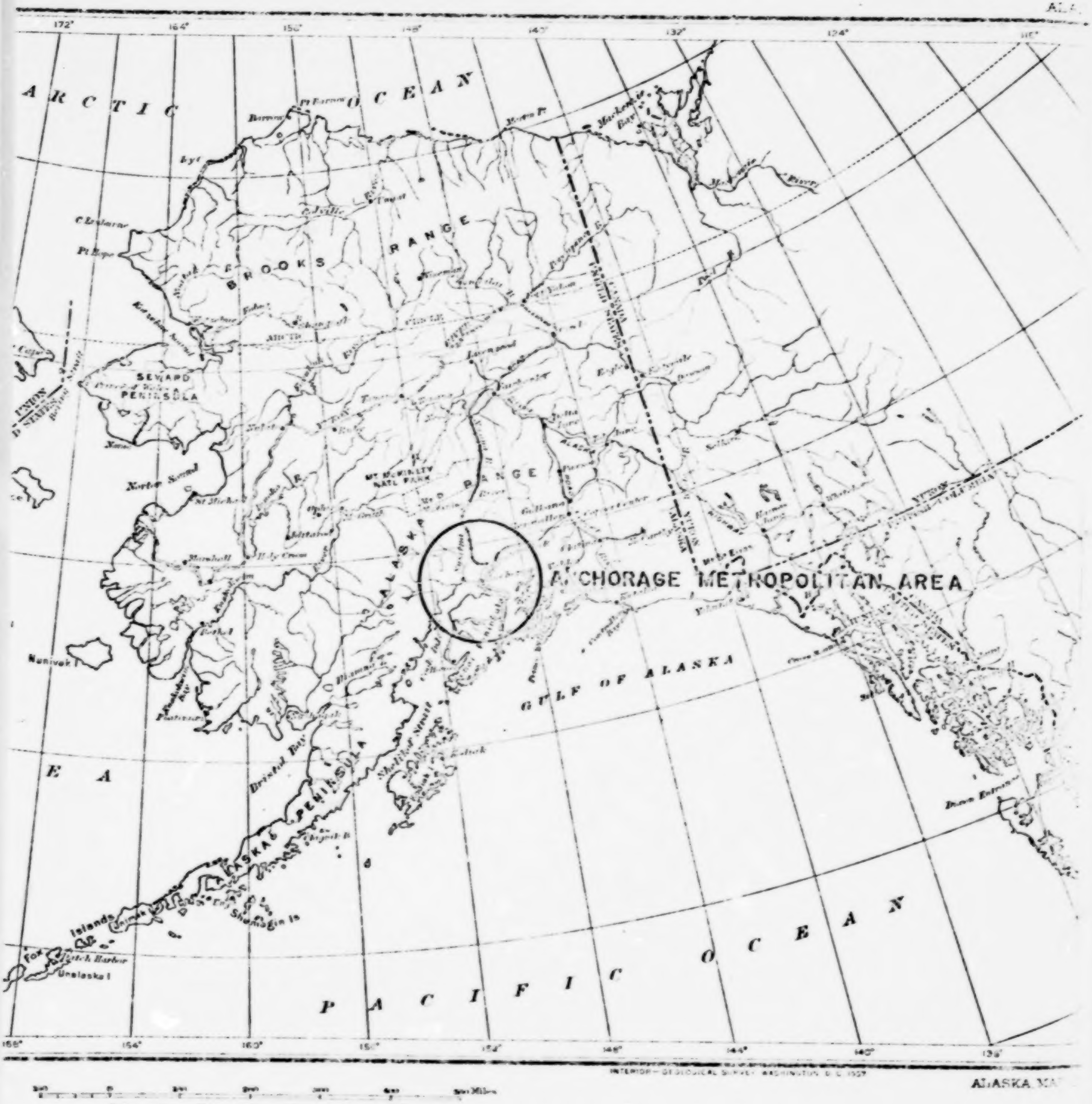
It must be emphasized that much of the effort in pollution control in Alaska, happily, will be in the category of preventive measures. Many large areas, where free of human activities, are also free of pollution. The Alaska State Water Quality Standards as now being promulgated and the existing statutes require that all waters be maintained in an unpolluted condition (with the possible exceptions of waters used for gravel washing and placer mining).

Waters of Alaska are today relatively free of pollution problems when the immense extent of bay, inlet and river water area is considered. When one considers only those waters near which there are industrial complexes or population centers, the picture changes. The waters near population and industrial centers are becoming polluted to a measurable extent and very little, if anything, is being done to slow the process.

It is apparent that precisely those practices which brought pollution to dangerous levels elsewhere, exist today in Alaska. These practices include (1) use of waters as a dumping ground for all types of refuse by individuals, (2) the widespread practices of direct dumping of sewage with no treatment, and (3) inadequate attention by industry to the prevention of pollution.

Pollution of Alaskan waters is assured if present trends are not reversed.

ANCHORAGE METROPOLITAN AREA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GULF OF ALASKA
Bristol Bay
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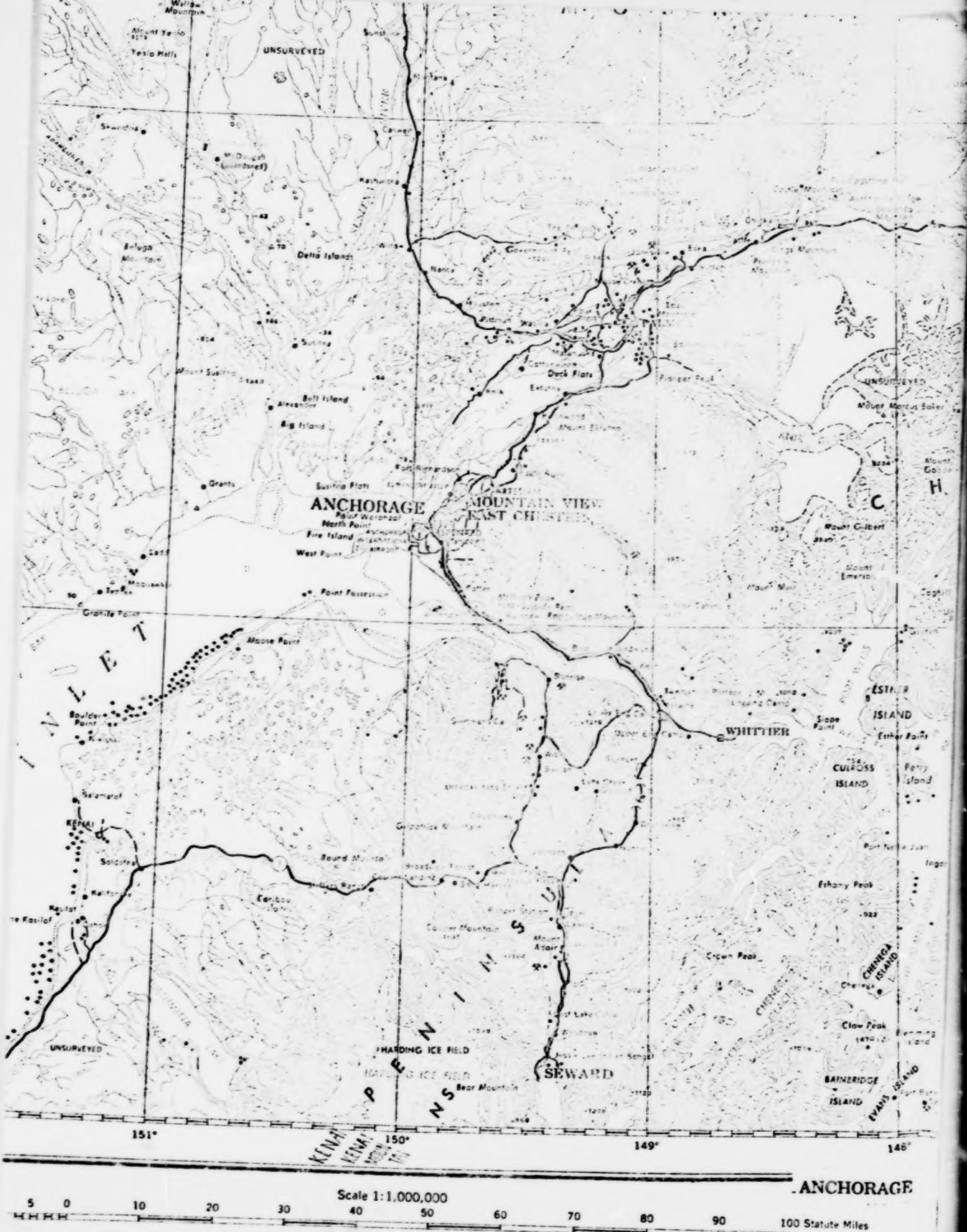
ANCHORAGE
MOUNTAIN VIEW
EAST CHESTER
WHITTIER
SEWARD
PALMER
KENAI
UNSURVEYED
HARDING ICE FIELD
INLET
PENINSULA
ESTHER ISLAND
CULROSS ISLAND
CHENEGA ISLAND
BAINBRIDGE ISLAND
EVANS ISLAND
Mount Yenlo
Yenlo Hills
Susitna
Mount Susitna
Beluga Mountain
Delta Islands
Bell Island
Alexander
Big Island
Granite Point
Point Possession
Moose Point
Boulder Point
Salamatof
Soldotna
Kasilof
Caribou Hills
Round Mountain
Cooper Mountain
Crown Peak
Claw Peak
Eshamy Peak
Slope Point
Esther Point
Perry Island
Mount Gilbert
Mount Emerson
Mount Marcus Baker
Duck Flats
Cottonwood
Point Woronzof
North Point
Fire Island
West Point
Susitna Flats
Bear Mountain
Mount Adair
Pioneer Peak
Chickaloon
Kashwitna
Willow
Nancy
Houston
Wasilla
Matanuska
Eklutna
Mount Eklutna
Grants
151°
150°
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148°
Scale 1:1,000,000
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10
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. ANCHORAGE

ANCHORAGE METROPOLITAN AREA

I. INTRODUCTION

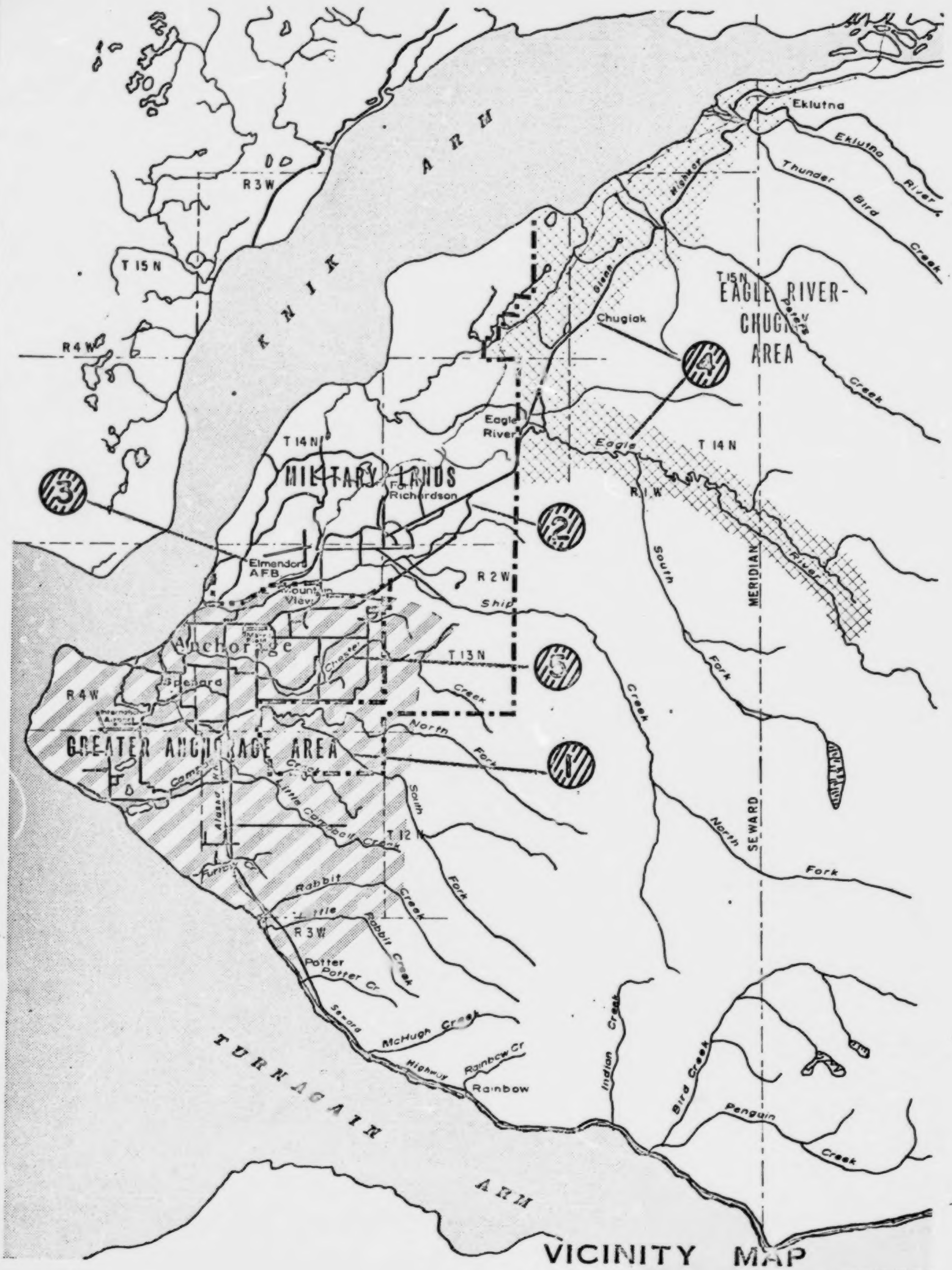
The purpose of this summary is to list and evaluate the sources and extent of pollution in the Anchorage metropolitan area of Alaska and to recommend actions designed to solve immediate problems.

The recommendations presented herein are based on studies and recommendations documented in references (1), (2) and (13) entitled respectively "Greater Anchorage Area Sewerage Study," "Eagle River - Chugiak Area Sewerage Study," both by a private consulting engineering firm, and "The Pollution of the Waters of Knik Arms" by the Alaska Department of Health. At the present time the Greater Anchorage Area Borough, an autonomous entity within whose political boundaries the area under consideration is contained, has adopted the two former studies as its master sewerage plan and is planning to present a referendum to its citizens for the authorization of bond sales.

The present pollution conditions are in violation of the Alaska Water Pollution Control Act and the Administrative Code; the Department of Health and Welfare therefore requires that at least primary treatment be given to the sewage from the City of Anchorage, Elmendorf Air Force Base, and Fort Richardson.

In addition to the State requirements, the Presidential Executive Order 11288 requires federal installations to provide secondary treatment for all wastes except cooling waters and fish hatchery wastes, or preferentially, to discharge wastes into municipal sewer systems providing adequate treatment.

Inasmuch as the recommendations presented in references (1) and (2) comply with these requirements, implementation of these recommendations is justified. The Alaska Water Laboratory, however,


KNIK ARM
R 3 W
T 15 N
R 4 W
Eklutna
Eklutna River
Thunder Bird Creek
Glenn Highway
T 15 N
EAGLE RIVER-CHUGIAK AREA
Chugiak
Peters Creek
4
Eagle River
Eagle River
T 14 N
T 14 N
R 1 W
MILITARY LANDS
Fort Richardson
3
2
Elmendorf AFB
R 2 W
Mountain View
Ship
Anchorage
T 13 N
5
Chester
Creek
Spenard
R 4 W
GREATER ANCHORAGE AREA
North Fork
1
Campbell
Little Campbell Creek
South Fork
T 12 N
South Fork
Creek
MERIDIAN
SEWARD
North Fork
Furrow Cr
Rabbit Creek
Little Rabbit Creek
R 3 W
Potter
Potter Cr
Potter Creek
Seward Highway
McHugh Creek
Rainbow Cr
Rainbow
Indian Creek
Bird Creek
Penguin Creek
TURNAGAIN ARM

VICINITY MAP

feels that the location of the proposed point of effluent discharge warrants further evaluation of oceanographic data.

II. SUMMARY OF MAJOR POLLUTION PROBLEMS, COSTS OF ABATEMENT, AND RESPONSIBLE AGENCIES

Responsible Agency and Nature of Waste	Immediate Treatment Needs	Estimated Cost to Correct	Relative Priority	Vicinity Map Index
City of Anchorage and Anchorage suburban area (domestic wastes)	Primary treatment and disinfection (to include Ft. Richardson, Elmendorf AFB, and Anchorage suburbs)	$ 26,500,000	(A)	1
Ft. Richardson U.S. Army (domestic wastes)	Primary treatment and disinfection	*	(A)	2
Elmendorf Air Force Base (domestic wastes)	Primary treatment and disinfection	*	(A)	3
Two privately owned canneries (fish cannery wastes)	Separation of solids at cannery and disposal of liquids to municipal sewer. Solids to be disposed of by owner of cannery in accordance with local solid waste disposal practices.	*	(A)	1
Greater Anchorage Area Borough (domestic wastes from Eagle River-Chugiak area)	Secondary treatment and disinfection	$ 650,000	(A)	4
City of Anchorage (proposed snow-melting plant wastes. High chloride and silt loading expected)	No immediate treatment needs, as future design and location of plant should have abatement provisions built-in.	No separable cost	(D)	NA
Ft. Richardson and Elmendorf AFB (grease rack and wash rack wastes)	Grease traps and sedimentation tanks.	$ 50,000	(B)	2,3

Responsible Agency and Nature of Waste	Immediate Treatment Needs	Estimated Cost to Correct	Relative Priority	Vicinity Map Index
Privately owned gravel washing plants (high silt loading)	Sedimentation	$ 100,000	(C)	5
	Total estimated costs	$ 27,300,000		

* The estimated cost to correct is included in the cost for the combined sewerage system for the City of Anchorage and Anchorage area. This cost includes interceptors and trunks but does not include laterals and house connections.

III. IMMEDIATE CONTROL NEEDS

The Anchorage metropolitan area, containing nearly half the total population of Alaska, has relatively high water quality needs. Anchorage is at the head of one of the largest migration routes for anadromous fish in Alaska. Fisheries are the largest industry in Alaska, and the continued discharge of untreated pollutants into these waters can be expected to cause the eventual depletion, both in quality and quantity of this valuable resource. The discharge of this untreated sewage also leads to deterioration of the waters and shore areas immediately surrounding Anchorage, creating potential health hazards and also leading to aesthetic and nuisance problems.

An increase in the bacterial pollution of groundwater has caused much concern, especially in those areas served by private shallow wells. The continued practice of discharging sewage into septic tanks and cesspools which connect directly to groundwater aquifers can only add to the potential health hazard now and, in proportion, increase as the surface area above the aquifers is residentially developed.

In order to abate the existing pollution problem in the Anchorage metropolitan area, the following immediate steps are recommended, in order of relative priority.

A. Construct a primary sewage treatment plant to treat all domestic sewage originating from Elmendorf Air Force Base, Fort Richardson, the City of Anchorage and its environs.

B. Construct interceptor and trunk sewers to transport sewage to the recommended plant from the foregoing areas.

C. Construct a collection system and secondary treatment plant for the Eagle River-Chugiak suburban area.

D. Install grease traps to separate oil and silt from wash and grease rack wastes at Fort Richardson and Elmendorf Air Force Base. Fort Richardson presently is in the programming stage of this project.

E. Install sedimentation facilities at gravel washing plants which presently discharge silt laden waste water in Chester Creek.

IV. RECENT PROGESS IN POLLUTION CONTROL

The Greater Anchorage Area Borough recently adopted a "Master Sewerage Plan" (1) and (2) which provides for the collection and treatment of all domestic sewage in the metropolitan area, including Fort Richardson and Elmendorf Air Force Base. The Eagle River-Chugiak area is proposed to be served immediately by a trunk and lateral system and a secondary treatment facility discharging to Eagle River, for a total immediate cost of $641,000.

It is proposed to serve the balance of the area by a primary treatment plant and by an interceptor and trunk system estimated to cost $26,000,000. The primary treatment plant effluent will discharge to Knik Arm via a submarine outfall. The consultant's recommendation to use only primary treatment for this portion of the area was predicated on oceanographic studies which indicate adequate dilution of the primary effluent. Chlorination of the effluent is also proposed. The AWL feels that the point of discharge requires further evaluation.

This proposal will eliminate the discharge of all untreated domestic and cannery sewage from the waters of Knik Arm and Eagle River. The proposed Eagle River facility will discharge chlorinated secondary effluent to Eagle River. The consultants compute that dissolved oxygen will not be lowered below 6-8 mg/liter in the Eagle River.

V. BACKGROUND FOR RECOMMENDATIONS

A. Pertinent Basin Characteristics

1. Geography (Also see maps on front piece)

The Anchorage metropolitan area is located at the head of Cook Inlet in southcentral Alaska. For the purpose of this report it is defined as the lowland west of the Chugiak Mountains, south of Eagle River and north of Rabbit Creek. It is bounded on the northwest by Knik and Turnagain Arms. The area defined covers about 160 square miles. It includes the City of Anchorage, several suburban communities, and two military bases, Elmendorf Air Force Base and Fort Richardson. Anchorage is the largest city in Alaska and the chief transportation center for this part of the State.

2. Topography and Geology

The Anchorage area is generally low lying, situated on glacial alluvium, rubble and till. Much of the terrain within this region is typified by rather flat lowlands, undulating and becoming progressively steeper near the base of the Chugiak Mountains.

The land surface in the Anchorage area slopes north and west from the Chugiak Mountains to Knik and Turnagain Arms. The altitude ranges from 1200 feet on the mountain slope to sea level along the estuaries. The wide plain that extends from Eagle River west to Point Woronzof and south to Rabbit Creek is the plain on which Anchorage and its environs are located. Tide flats border the shore of Turnagain and Knik Arms and extend in to the mouths of most of the streams which cross the lowland.

3. Climate

The surrounding mountain barriers prevent the Anchorage area from having the temperature extremes of the interior of Alaska and the heavy precipitation of regions along the Gulf of Alaska. The average annual rainfall, based on standard normals for the period 1931-1960, is 14.71 inches. In most years the winter and spring are relatively dry. About 48 percent of the mean annual precipitation recorded at Anchorage falls during the 3-month period July-September. The average seasonal snowfall is about 5 feet.

The spring and fall at Anchorage are characteristically short, the summer cool, and the winter moderately cold. The average annual temperature based on standard normals for the period 1931-1960 is 35.2° F. The lowest temperature recorded was -38°F. in February 1947 while the highest was 86° F. in June 1953. Temperatures as high as 80° F. are uncommon. The average frost free season is 112 days. The ground usually begins to thaw in April or May and to freeze in October. During the winter the ground commonly freezes to depths of 6 to 8 feet and deeper where the snow has been removed. Cloudy days are common and contribute to the low rate of evaporation which ih turn favors the growth of forest where the climate is semiarid by middle-latitude standards.

4. Population

The present population of the Greater Anchorage Area is about 115,000, excluding the Eagle River-Chugiak area. Forecast growth for this area predicts a population of 260,000 persons by 1980.

The Eagle River-Chugiak area presently has a population of 4,600 persons and growth patterns indicate a population of 7,100 persons by 1970 and 19,000 persons by 1980.

5. Industry

There is very little industry in the Anchorage metropolitan area. With the possible exception of fish processing, major forecast activity is in transportation and light industry, which may be expected to have relatively low water use and waste production rates.

Present industrial type wastes consist of the following:

Cooling water discharges from the power plants at Elmendorf Air Force Base, Fort Richardson, and the Chugiak power plant at Ship Creek. It could be noted that the cooling ponds of the first two are presently used as fish hatcheries for salmon and trout. The effect of increased temperatures caused by blowdown from these ponds may have some bearing on fish population, but this effect has not been fully evaluated.

There are two seafood processing plants discharging wastes into Knik Arm on a seasonal basis.

There are several gravel washing plants dumping a large amount of silt into Chester Creek on a seasonal basis.

6. Streams and Rivers

The streams in the Anchorage area are Ship Creek, and Rabbit Creek, which arise in the mountains, and Chester Creek, which arises in the lowland. All these streams flow to tidewater and are tidal near their mouths. The range of tidal fluctuation in the estuaries is commonly 30 feet or more. Within the lowland plain are many depressions and flat areas that are marshy. Shallow lakes are common in these places, especially southeast of Anchorage.

All the streams in the Anchorage area, except Eagle River, are non-glacial. The stream flows are provided by surface runoff and groundwater seepage. Where the streams emerge from the mountains onto lower ground, the stream beds are higher than the surrounding water table, and in such areas water is lost from the streams. However, when the streams leave the mountains and cross the lowlands to the inlet, the streams have incised their beds to relatively low elevations in respect to the water table and thus are, at the present time, receiving water from the surrounding areas. Deep well pumping in the Anchorage area has no effect on the surface water levels. Draining or installing a municipal sewer system which would reduce the surface water input would lower the surface water level and affect the surface water inflow to the lowland streams.

a. Chester Creek

Chester Creek is about seven miles long and drains a lowland surface area of about twenty square miles. It flows from Muldoon Road to Knik Arm. Chester Creek derives most of its flow from water contributed from swamps, springs and drainage ditches. The water during the summer is brown. The average yearly discharge is about 24 cfs. A high maximum flow of 95 cfs occurred during April 1965, and the lowest flow recorded was 4 cfs during March 1964. The expected temperatures would be in the range of 32° F. to 65° F.

Chester Creek formally supported a small run of coho and chum salmon and a run of Dolly Varden char. Concurrent with industrial and civic development, Chester Creek has become less productive of these fish species owing to disrupted flows and spawning gravels. The Alaska Department of Fish and Game has written off Chester Creek as a producer of sport and commercial fishes. It is, however, included in the proposed "Greenbelt" for the City of Anchorage.

b. Ship Creek

Ship Creek flows approximately 22 miles from headwater tributaries high in the Chugiak Mountains to the tidewater of Knik Arm. The drainage area of 113 square miles has provided maximum flows of 766 cfs during June 1964 and 2 cfs minimum flows during March 1964. These measurements were made at the Elmendorf power plant location about 2 miles from the mouth of the stream. Considerably larger flows have been recorded at the City's municipal water diversion dam at 11.5 mile, and at periods during the winter the total Ship Creek flows at this point have been diverted.

The City of Anchorage, Fort Richardson, and Elmendorf use Ship Creek for domestic water supply. A 40-foot dam for diverting domestic water is located approximately 11.5 miles above its mouth. Below this domestic diversion, three steam power plants divert water for turbine condenser cooling. A total of four diversion dams are installed within the first eight miles. Incremental flows entering below the City's 40-foot dam maintain sufficient water to operate these cooling ponds.

Historically, Ship Creek has a record of producing a large run of king and pink salmon. Chum salmon are present in small numbers. Dolly Varden char and rainbow trout are present but are not numerous in the system. The stream is closed to salmon fishing. Fish passage facilities are provided at the diversion dams, and salmon and trout can pass, when water conditions are favorable, to the base of the 40-foot dam at 11.5 mile. Spawning gravels are good, and it has been estimated that enough gravel is available to meet the requirements of 21,000 king salmon. During recent years fewer than 100 king salmon have been observed in Ship Creek. Pink and chum salmon use the lower three miles of the creek.

Oil pollution in the stream has occurred several times from Elmendorf Air Force Base. The oil has been traced to leaking storage tanks, and during 1962 an oil separator was installed to prevent oil from entering the stream. Coal dust from flue cleaning at the power plant has been allowed to enter Ship Creek, but the effects of this discharge have not been evaluated.

Water that is diverted from Ship Creek to the power plants is circulated through cooling ponds. The water from these ponds is used for condensing steam in the turbine system. Since the water gradually increases in temperature, water is added from Ship Creek and then discharged from the pond back into Ship Creek. The result is a small increase in the temperature of the stream. During the winter the discharged water is warm enough to prevent the formation of ice. The Fort Richardson and Elmendorf cooling ponds have been used for many years to rear rainbow trout. The trout are supplied from the Alaska Department of Fish and Game, Fire Lake Hatchery, introduced into the warm cooling pond water, feed on prepared food and raised to stockable size. The fish are used to stock lakes and streams located on military reservations and to some extent other areas outside the jurisdiction of the military.

c. Campbell Creek

Campbell Creek is similar to Ship Creek in that it has its origin in the Chugiak Mountains; however, the drainage area of 30 square miles is much smaller. The maximum flows recorded occurred during June 1949 when nearly 900 cfs was recorded, and the lowest was 0 during October of 1958.

Coho, king, and a few pink salmon enter the system for spawning purposes. Dolly Varden and stickleback are present in the stream and reservoir.

An earth-fill dam was constructed across Campbell Creek at tidewater in 1958 forming a reservoir of about 80 acres. Access into the lake for fish has been provided by a culvert and boulders which allow fish to pass during high tides. No pollution has been reported, although extensive housing developments have been erected along its banks in recent years. The lake and stream are under study by the Alaska Department of Fish and Game for possible stocking and rehabilitation of the sports fishery.

d. Rabbit Creek

Rabbit Creek arises in the Chugiak Mountains and flows from a small lake located at the 3,000-foot elevation to tidewater on Turnagain Arm, a distance of about 10 miles. No stream gaging has been conducted on Rabbit Creek, and no temperature information is available. Judging from the size of the watershed, Rabbit Creek is probably smaller than Campbell Creek. It would be expected to contain little or no flow during the coldest winter months and discharge up to 400 cfs during periods of high runoff.

Very little information is available regarding fish. The Alaska Department of Fish and Game is studying a small remnant run of pink salmon. A few cohos could be expected to enter the stream also. While no pollution has been reported to date, house construction with attendant land clearing may be expected to provide some increase in silt load, and increased human habitation could eventually pollute this stream which at present is, except for the area near its mouth, still in its natural state.

e. Eagle River

Eagle River flows from the base of Eagle Glacier 25 miles to Knik Arm. Several fairly large tributaries enter the main water course along the way; many of these are glacial fed. Eagle River is clear during the winter and turbid with glacial melt during the rest of the year. Owing to its glacial origin and partially to its larger size, Eagle River is cooler than surface runoff streams. The turbid water during the summer limits the growth of aquatic plants and animals. Tributary streams and side channels of the main river provide suitable spawning and rearing areas for anadromous fish.

Eagle River supports all five species of Pacific salmon. Besides king, coho, pink, and chum, sockeye have been found to spawn here in significant numbers. Dolly Varden char are also present. There are no reports of rainbow trout in the drainage.

Fort Richardson discharges untreated sewage through a 30-inch outfall into a small tributary of Eagle River. The outfall is located in the southwest corner of T. 14 N., R. 2 W., about 3 miles northeast of Otter Lake.

The Eagle River valley above the highway bridge has been set aside for a power and domestic water source by the City of Anchorage. The site is under preliminary permit No. 2405 by the Federal Power Commission.

Homesteading above the reservoir withdrawal area has gradually taken up all the available land on the north side of Eagle River. A good all-weather road connects most of these lands to the Glen Highway at the town of Eagle River. Housing developments are gradually replacing the homesteads and can be expected to provide a source of future pollution as the trend toward urban sprawl encroaches upon the Eagle River area.

7. Vegetation

Plant cover follows three distinct types. In well-drained areas the forest consists of white spruce, cottonwood, aspen, birch willow, and alder. Along the tidal flats and at the mouths of streams, the vegetation is particularly sparce owing to the frequent tidal flooding. Only salt-tolerant plants are found. In the poorly-drained land above tidal influence the ground cover is predominantly moss, sedge, grass, and other marsh plants. Black spruce, birch and alder grow in a few marshy places. Peat has formed in most of the bogs.

B. Present Water Quality

1. Domestic Pollution Sources

At the present time domestic sewage from the following areas is being discharged untreated directly or indirectly into the water of Cook Inlet through the following sewers and numerous other small outfalls:

	Population	Average Flow (MGD)
a. City of Anchorage	21,700	3.11
b. Spenard area	13,500	1.85
c. Elmendorf	16,100	1.28
d. Ship Creek	3,450	1.14 (much infiltration)
e. Fort Richardson (Eagle River)	12,700	1.11

	Population	Average Flow (MGD)
f. Governement Hill	3,700	.26
g. Turnagain Heights sewer	small	-
h. International Airport sewer	small	-

2. In addition to the direct discharge into Cook Inlet of domestic wastes, many suburban areas of metropolitan Anchorage utilize separate home septic tanks or cesspools which discharge into the ground. As the population of the metropolitan area is presently estimated at about 115,000 persons, this signifies that the sewage contributed by about 45,000 persons is disposed of in this manner.

Except for Fort Richardson, all of the raw domestic sewage is discharged into Knik Arm. Although the dilution available is theoretically infinite in this body of water, there is evidence of local pollution by the existence of unsightly and odorous solids on the shores. Some of the outfalls are accessible to children playing on the shore, thereby presenting a health hazard.

Fort Richardson discharges its sewage to the ground surface from whence it meanders about one mile across marshland to Eagle River and thence into Knik Arm. This practice makes direct contact accessible to animals or persons who may be in the area. Upon reaching the Eagle River, a dilution factor of 1.7 to 1 is available based on minimum winter flows of 4.8 cfs in the Eagle River and maximum discharge of sewage of 1.82 MGD from Fort Richardson. Although this is an exceptionally low dilution factor, the effect on the Eagle River may be alleviated by the one-mile overland travel of the raw discharge, which would be conducive to removal of solids and re-aeration of the effluent before merging with the Eagle River.

The discharge of individual home septic tank effluent or cesspool effluent is conducive to pollution of ground water sources. This is evidenced by the increasing frequency of bacteriologically polluted wells in the area, as determined by Alaska Department of Health tests.

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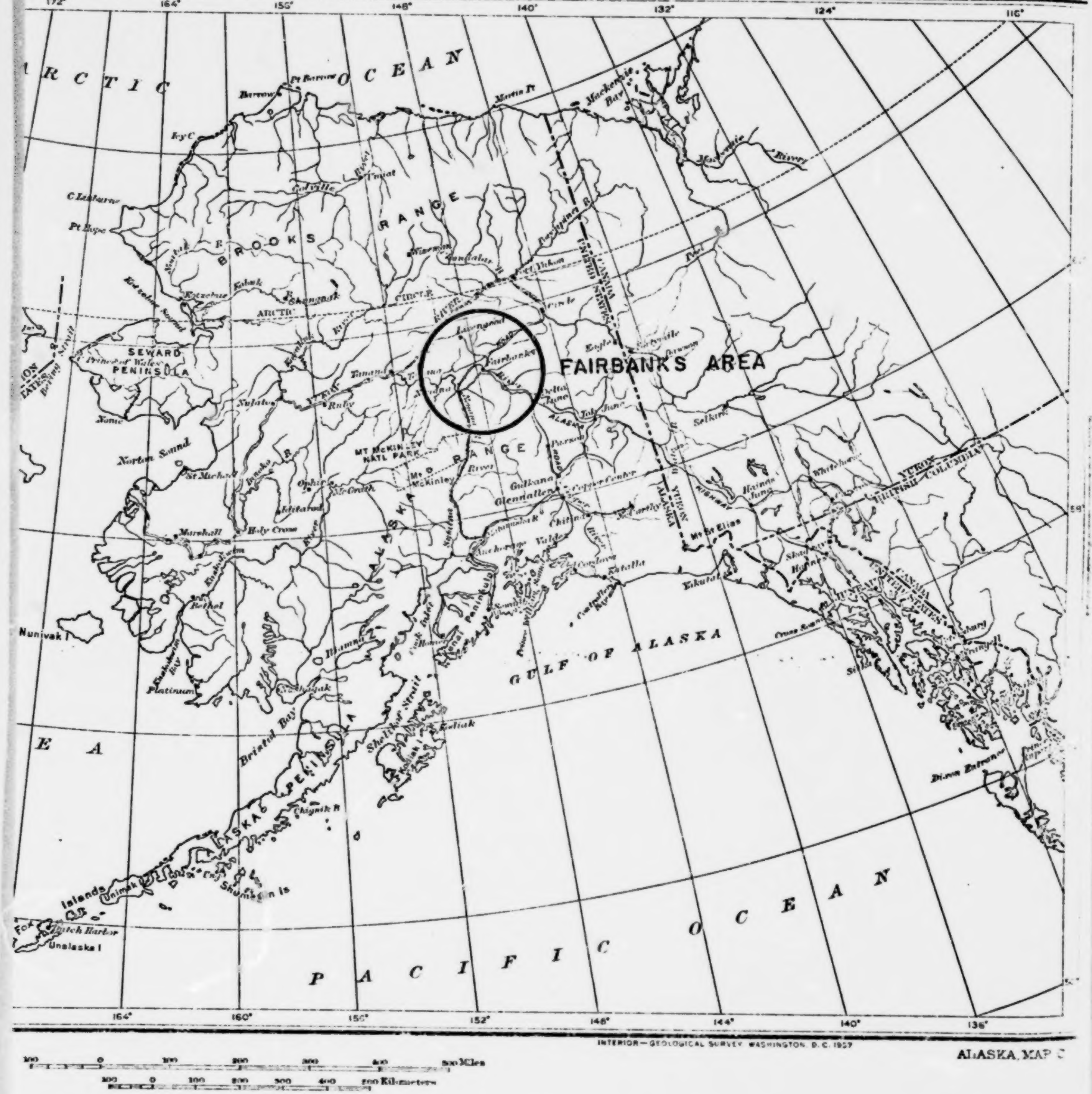
FAIRBANKS AREA


FAIRBANKS AREA
ARCTIC OCEAN
BROOKS RANGE
SEWARD PENINSULA
ALASKA RANGE
MT McKINLEY NATL PARK
Mt McKinley
Fairbanks
Circle
Eagle
Delta Junc
Tok Junc
Gulkana
Glennallen
Copper Center
Chitina
Valdez
Cordova
Anchorage
Seward
Homer
Kodiak
Shelikof Strait
Bristol Bay
ALASKA PENINSULA
Cook Inlet
Kenai Peninsula
Iliamna L
Dillingham
Platinum
Bethel
Nunivak I
Marshall
Holy Cross
McGrath
Ophir
Iditarod
Ruby
Nulato
Tanana
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Nome
Norton Sound
St Michael
Kotzebue
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Pt Hope
C Lisburne
Icy C
Barrow
Pt Barrow
Martin Pt
Mackenzie Bay
Mackenzie River
Whitehorse
Haines Junc
Mt St Elias
Yakutat
Cross Sound
Sitka
Juneau
Skagway
Haines
Wrangell
Dixon Entrance
YUKON
BRITISH COLUMBIA
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164° 160° 156° 152° 148° 144° 140° 136°
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INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C. 1937

ALASKA, MAP C

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FAIRBANKS AREA

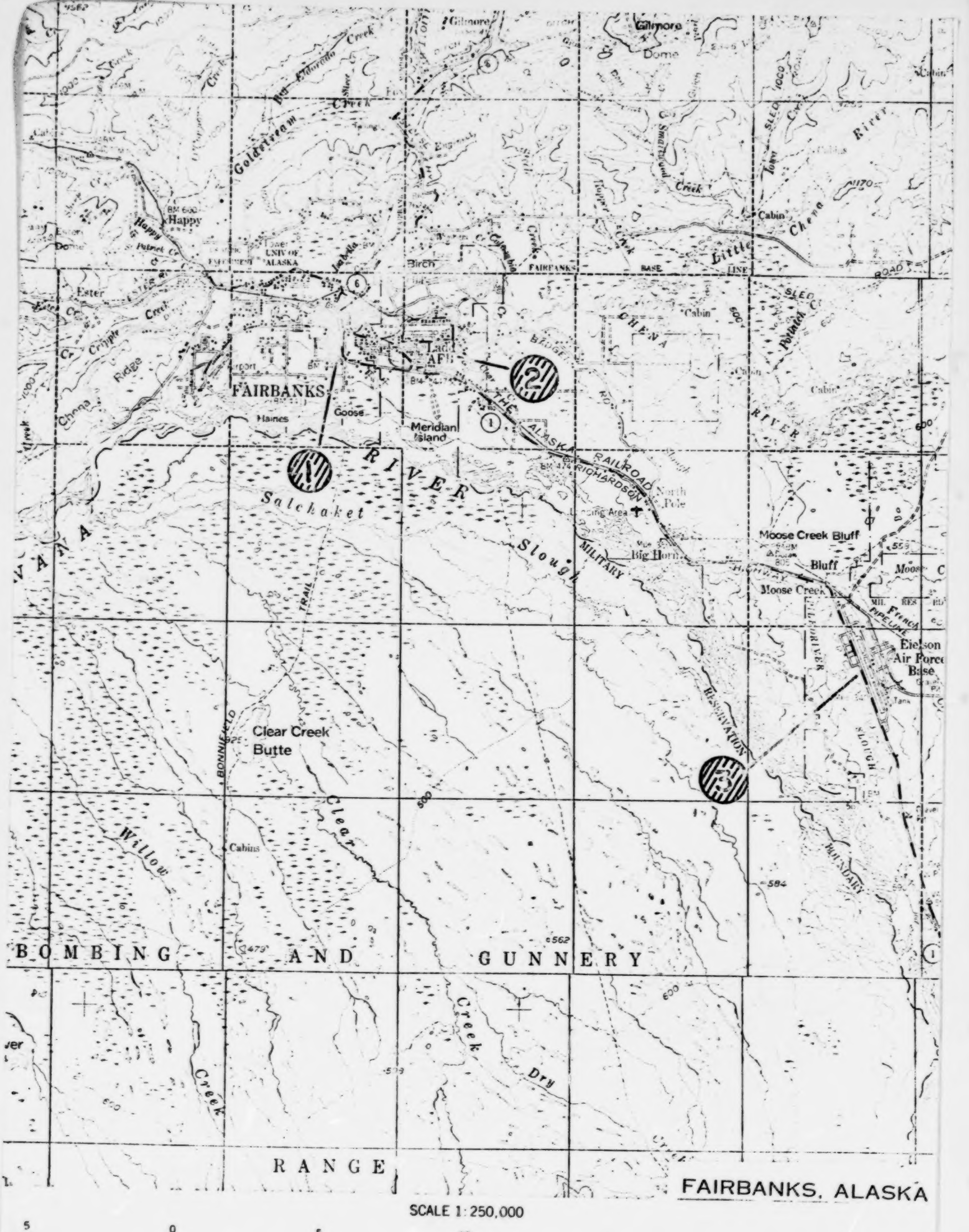
I. INTRODUCTION

The purpose of this summary is to list and evaluate the sources and extent of pollution in the Fairbanks area of Alaska and to recommend actions designed to solve immediate needs.

Although the City of Fairbanks, University of Alaska, Fort Wainwright, and Eielson Air Force Base provide treatment for their sewage, the balance of the area disposes of its wastes either directly to the Chena River, the Tanana River or through cesspools and septic tanks directly into the ground. The discharge of untreated sewage into ground water aquifers or to surface streams is in violation of the Alaskan Water Pollution Control Act and the State of Alaska Administrative Code; the Department of Health and Welfare requires that at least primary treatment be given to all sewage before discharge to the waterways.

In addition to the state requirements, the Presidential Executive Order 11288 requires federal installations to provide secondary treatment for all wastes. A preferred method is to discharge to a municipal system with adequate treatment.

A detailed study was not made in the preparation of this summary. It was presumed that a complete engineering design analysis will preclude physical implementation of the recommendations presented herein.


Gilmore
Gilmore Dome
Goldstream Creek
Big Eldorado Creek
Happy
Ester Dome
Ester
Cripple Creek
Chena Ridge
UNIV OF ALASKA
Birch
FAIRBANKS
BASE LINE
Ladd AFB
Goose
Haines
Meridian Island
Chena Slough
Little Chena River
Chena River
SLED ROAD
Potlatch Cr
Cabin
THE ALASKA RAILROAD
RICHARDSON MILITARY HIGHWAY
North Pole
Landing Area
Big Horn
Moose Creek Bluff
Bluff
Moose Creek
Eielson Air Force Base
FRENCH PIPELINE
MIL RES
RESERVATION BOUNDARY
TANANA RIVER
Salchaket Slough
TRAIL
BONNIFIELD
Clear Creek Butte
Clear Creek
Dry Creek
Willow Creek
Cabins
BOMBING AND GUNNERY RANGE
1
2
3
6
8
5
0
5
10

FAIRBANKS, ALASKA

SCALE 1:250,000

II. SUMMARY OF MAJOR POLLUTION PROBLEMS, COSTS OF ABATEMENT, AND RESPONSIBLE AGENCIES.

Responsible Agency and Nature of Waste	Immediate Treatment Needs	Estimated Cost to Correct	Relative Priority	Vicinity Map Index
Fairbanks North Star Borough (Domestic Wastes)	Assumption of health powers by Fairbanks North Star Borough and immediate initiation of an engineering sewer study, followed by implementation. Fort Wainwright should be included in such a study. The Borough presently has a comprehensive plan in the process of preparation, but this plan is not expected to include sufficient detail to provide the basis of satisfying immediate needs.	$150,000 (for an engineering design analysis) $12,000,000 (for implementation)	(A+) (A)	1
Fort Wainwright (Domestic Wastes)	Supplement the existing primary system with secondary treatment and disinfection.	$2,000,000	(C)	2
Eielson Air Force Base (Domestic Wastes)	Supplement the existing primary system with secondary treatment and disinfection.	$100,000	(B)	3

III. IMMEDIATE CONTROL NEEDS

The Fairbanks area is characterized by a haphazard arrangement of subdivisions surrounding the City of Fairbanks. Except for the City itself, the University campus, Fort Wainwright and Eielson Air Force Base, all other areas of the Fairbanks North Star Borough, including those areas immediately outside the city limits, dispose of their sewage into septic tanks, cesspools or by direct discharge into the nearest slough or stream. Since all water supplies in this area originate in ground water aquifers, the effect on potable water quality has been very noticeable. Over 50% of all non-public water supplies show evidence of sewage pollution. This condition has caused much concern by health authorities, especially for those areas served by private shallow wells.

The areas bordering on the Fairbanks city limits could solve their problem by petitioning for annexation to the City and connecting to the municipal sewer system. They could also petition the Fairbanks North Star Borough, a recently constituted autonomous governmental entity, to develop a service district for the purpose of providing sewer service to a specific area. A preferable solution, however, would be for the Fairbanks North Star Borough to assume the responsibility of providing sewers by referendum and to provide sewer service to citizens on an area-wide basis.

In order to abate the existing pollution problem in the Fairbanks area, the following immediate steps are recommended in order of relative priority.

A. The Fairbanks North Star Borough should immediately assume sewer powers followed by the authorization of an engineering sewer study followed by implementation of the study. Fort Wainwright, because of its proximity to the City of Fairbanks and to the proposed sewered area, should also be included in this study. The probability is that participation in an area-wide sewer plan would be more economical than providing separate treatment. On this basis it may be desirable to hold any action on the proposed Fort Wainwright sewage treatment facility until such time as a detailed engineering analysis determines whether this would result in the least cost to the taxpayer.

B. Construct a secondary treatment facility to supplement the existing primary facility at Eielson Air Force Base for the purpose of improving the quality of primary effluent which is presently being discharged to Garrison Slough.

IV. RECENT PROGRESS IN POLLUTION CONTROL

There has been a relatively large amount of information gathered in the Fairbanks area concerning pollution. The State Department of Health and Welfare has made several bacteriological and chemical surveys of the Chena River and other streams in the local area, and the state sanitarian is at present monitoring the quality of potable water supplies from a bacteriological and detergent standpoint. The Alaska Water Laboratory is also monitoring the quality of the Chena River as well as other streams in the immediate area and performing chemical and bacteriological tests. The Fairbanks North Star Borough is in the process of compiling a comprehensive study of the Fairbanks North Star Rural Area, a portion of which will be devoted to a water and sewer study. The Corps of Engineers is completing the second phase of a report of the Fairbanks flood control project. This project envisions a dam and reservoir in the Chena River upstream from the Fairbanks area. The pollution load in the Chena River will be definitely affected by the control of discharge from this proposed reservoir. The DOD plans to program construction projects to abate pollution in the near future. Their plan for controlling environmental pollution has been approved by the Federal Water Pollution Control Administration.

V. BACKGROUND FOR RECOMMENDATION

A. Pertinent Characteristics

1. Geography

The City of Fairbanks and its environs is located in the valley of the Chena River near river mile 10 and the Tanana River near river mile 210. This valley lies in the central plateau region approximately 250 air miles northeast of Anchorage and 130 miles south of the

Arctic Circle. Although its elevation is only about 400 feet above mean sea level, it is well sheltered from maritime influences by mountain ranges on practically all sides.

2. Climate

The climate of the basin in which Fairbanks lies is continental in nature and is characterized by cold dry winters and warm, relatively moist summers. The total precipitation is low, averaging about 12 inches. Annual snowfall is about 60 inches.

The temperatures over the basin are characterized by their great seasonal variation. Subzero temperatures prevail in the winter months while summer temperatures are as warm as portions of western and northern United States. At Fairbanks the all-time minimum temperature is minus 66°F, and the highest temperature on record is a plus 93°F.

3. Vegetation

The vegetation within the basin consists of heavily forested mountains changing to muskeg and scrub in the lowlands. The low areas are typified by willows, sedges, black spruce, potholes, and hummocky tundra scattered over permafrost, while the better drained lands support stands of white spruce, poplar, and birch.

4. Population

The present population of the Fairbanks-Fort Wainwright-College-Lemeta complex is approximately 40,000 persons. Expansion of the population since 1960 shows a continuation of the "boom" quality. Indications are that this expansion will continue for some time.

5. Economy

The City's central location gives it an advantage over other Alaskan cities in functioning as the trade and distribution center of the vast interior. Trade is the important ingredient in the economy of Fairbanks. Without it the city cannot prosper. Because of the distances involved, transportation costs are high and labor is an expensive commodity in Fairbanks. Also due to its relative isolation, climatic conditions, high transportation, and development costs, the potentials of the interior, mining, agriculture, and forestry have been slow to materialize. As a result of these factors, the economic well-being of Fairbanks continues to be dependent upon construction associated with military programs, service and retail functions, government, and transportation.

6. Rivers

The important streams in the Fairbanks area are the Chena and Tanana Rivers.

a. Chena River

The Chena River originates in a mountainous region about 90 air miles east of Fairbanks and discharges into the Tanana River below Fairbanks. It is an unregulated river approximately 150 miles long with a watershed of about 1980 square miles. The average annual discharge at Fairbanks is 1344 cfs with a range of 100-24,200 cfs. Maximum discharge is reached in April and May with normal flows occurring in the summer and extreme low flows occurring during the winter season. Water temperatures range from near 32° F. in the winter to about 60° F. in July. Ice begins to form in October and spring breakup occurs in April and May.

b. Tanana River

The Tanana River originates in the glaciers of the Wrangell Mountains in Yukon Territory, Canada, approximately 250 air miles southeast of Fairbanks. It flows in a northwesterly direction to empty into the Yukon River at Tanana approximately 125 air miles west of Fairbanks. It is approximately 600 miles long, unregulated but greatly affected by glaciers. The average discharge near Fairbanks in 1965 was 22,010 cfs while the maximum recorded discharge is 117,000 cfs. Maximum flows occur in the spring and minimums occur during the late winter. Temperatures range from near 32° F. to a maximum of 55° F. Ice begins to appear in late September, and breakup occurs in April and May.

Both rivers support substantial salmon runs and also contain an endemic population of sport fish such as grayling, pike, ling cod and whitefish.

B. Present Water Quality Problems

At the present time, Eielson Air Force Base discharges approximately 80,000 GPD of primary effluent to Garrison Slough, which flows into the Tanana River. The State Department of Health has been concerned about the evidences of pollution in this waterway. The construction of secondary treatment facilities to supplement the existing primary sewage treatment plant at Eielson should alleviate this condition. Fort Wainwright presently discharges approximately 600,000 GPD of primary effluent into the Chena River upstream from Fairbanks. The Fairbanks municipal primary sewage treatment plant discharges the sewage contributed by about 17,000 persons into the Chena River. Further downstream, a secondary treatment plant managed by a private utility company discharges secondary effluent into the Chena River, contributed by the University of Alaska with a population of approximately 2,000 persons. The balance of the population of the Fairbanks North Star Borough, consisting of approximately 15,000 persons, discharges raw sewage directly into the Chena, or to numerous sloughs connecting to it, or to septic tanks or cesspools with insufficient horizontal clearances.

The groundwater table is high in the Fairbanks area, and in most places is within several feet of the surface. The State Department of Health and Welfare is continually performing detergent and bacteriological analyses of water supplies in the Fairbanks area. The following results from sampling in various subdivisions surrounding the City of Fairbanks are given to illustrate the seriousness of groundwater pollution. Detergent analysis results taken from December 1, 1963 through March 10, 1964 are: Hamilton Acres 70% positive; Aurora Subdivision 50% positive; McKinley Acres 75% positive; College area 75% positive. The average value of all the samples taken indicates that 61% were positive. As could be expected, the waters of the Chena River show high coliform counts and significant levels of BOD. However, because of cold water temperatures and the short distance from the outfalls to the Tanana River, where an exceptionally high dilution factor is available, there is no noticeable oxygen sag curve in the Chena River.

Due to the recent construction of a mine-mouth power plant at Healy, the anticipated shutdown of the local Golden Valley Electric Association power plant has caused a great deal of concern in the communities bordering Noyes Slough, a tributary of the Chena River. With the cessation of the discharge of cooling water into Noyes Slough, numerous private outfalls presently discharging into it will have no dilution whatever.

The population density of the presently unsewered Fairbanks environs has increased to the extent that it would be economically feasible to provide sewers for the majority of these areas. It is almost mandatory to provide such service considering the amount of polluted groundwater which presently supplies the numerous individual shallow wells.

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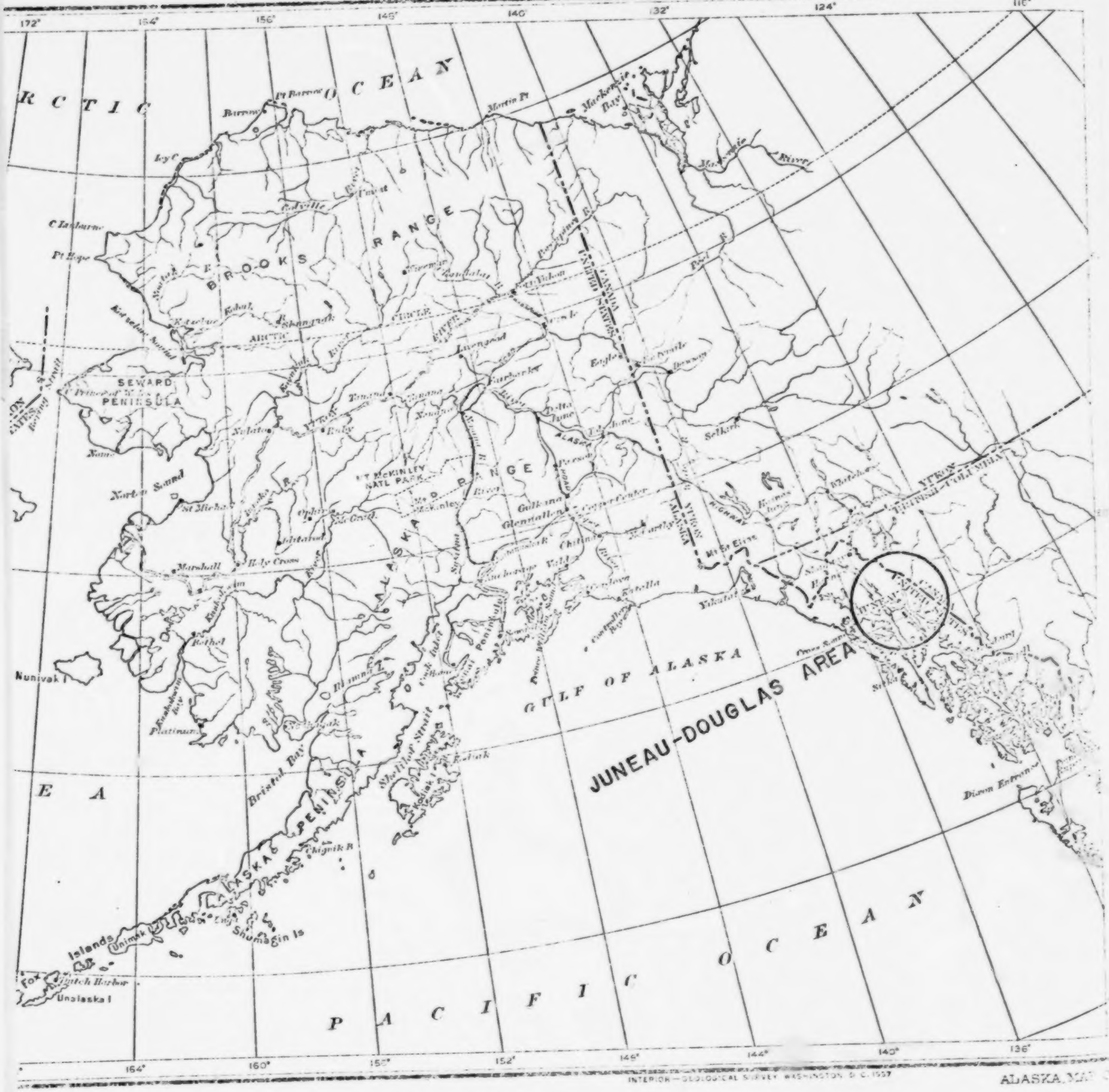
JUNEAU-DOUGLAS AREA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Wiseman
ARCTIC CIRCLE
Kotzebue Sound
SEWARD PENINSULA
Bering Strait
Nome
Norton Sound
St Michael
YUKON RIVER
Tanana
Fairbanks
Eagle
Dawson
Selkirk
ALASKA RANGE
MT McKINLEY NATL PARK
Mt McKinley
Gulkana
Glennallen
Copper Center
Chitina
Valdez
Cordova
Katalla
Yakutat
Mt St Elias
Whitehorse
YUKON
BRITISH COLUMBIA
JUNEAU
Sitka
Dixon Entrance
Marshall
Holy Cross
Bethel
Kuskokwim
Nunivak I
Platinum
Bristol Bay
ALASKA PENINSULA
Shelikof Strait
Kodiak I
Chignik B
Shumagin Is
Unimak I
Fox Islands
Dutch Harbor
Unalaska I
GULF OF ALASKA
JUNEAU-DOUGLAS AREA
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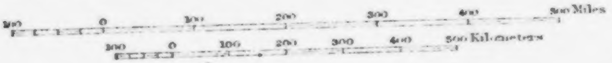
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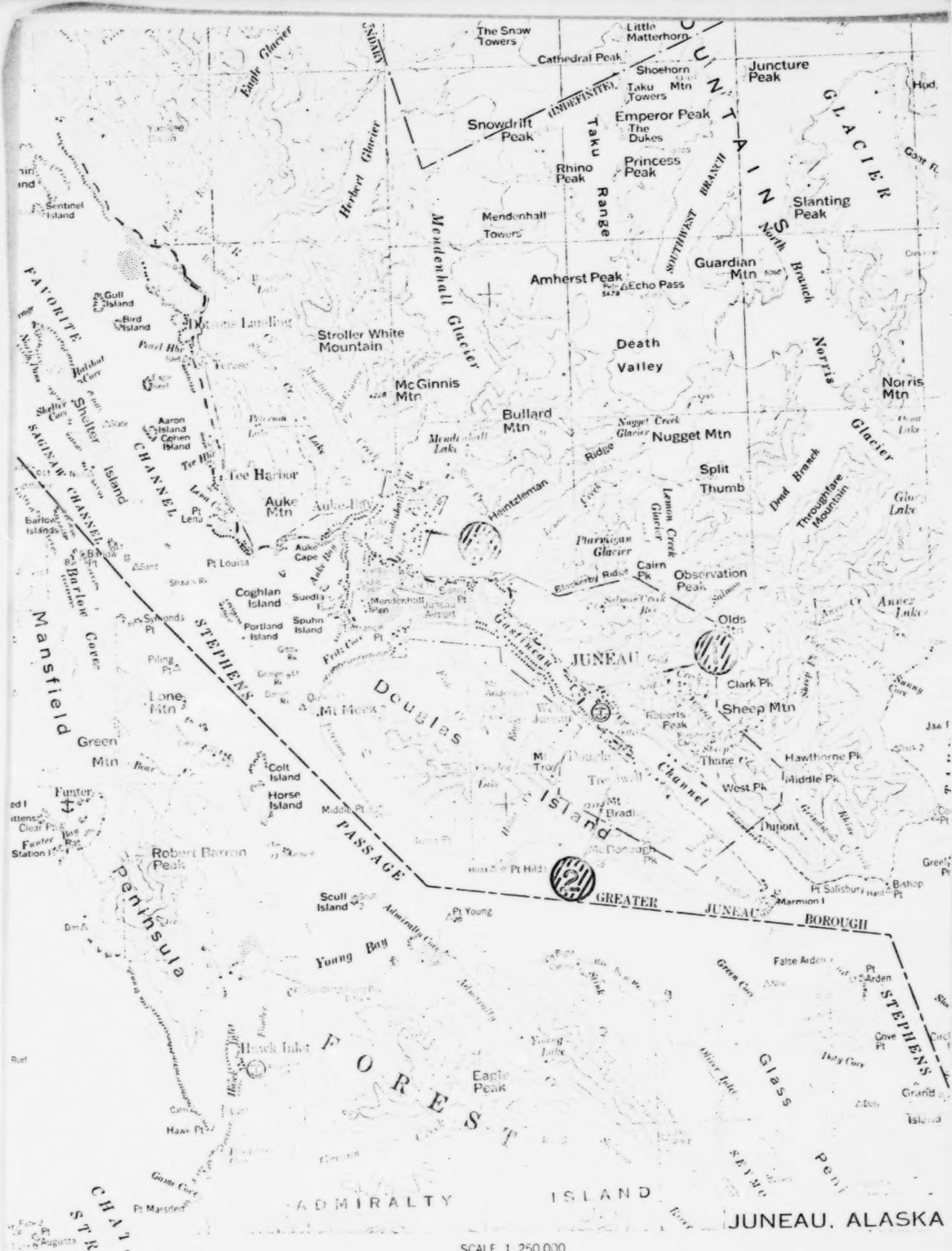


The Snow Towers
Little Matterhorn
Cathedral Peak
Shoehorn Mtn
Taku Towers
Juncture Peak
Eagle Glacier
Snowdrift Peak
(INDEFINITE)
Emperor Peak
The Dukes
Taku Range
Rhino Peak
Princess Peak
SOUTHWEST BRANCH
MOUNTAINS
GLACIER
Slanting Peak
Herbert Glacier
Mendenhall Glacier
Mendenhall Towers
North Branch
Guardian Mtn
Amherst Peak
Echo Pass
Sentinel Island
FAVORITE
Gull Island
Bird Island
Dotsons Landing
Stroller White Mountain
Death Valley
Norris Glacier
Norris Mtn
McGinnis Mtn
Bullard Mtn
Nugget Creek Glacier
Nugget Mtn
Ridge
Aaron Island
Cohen Island
Shelter Island
CHANNEL
SAGINAW CHANNEL
Mendenhall Lake
Split Thumb
Dead Branch
Throughfare Mountain
Tee Harbor
Auke Mtn
Auke Bay
Heintzleman
Lemon Creek Glacier
Glory Lake
Pt Lena
Barlow Islands
Ptarmigan Glacier
Cairn Pk
Observation Peak
Blackerby Ridge
Annex Lake
Auke Cape
Pt Louisa
Coghlan Island
Suedla
Mendenhall Pen
Juneau Airport
Portland Island
Spuhn Island
Entrance Pt
Olds Mtn
JUNEAU
Symonds Pt
Barlow Cove
Mansfield
STEPHENS
Gastineau Channel
Piling Pt
Douglas Island
Clark Pk
Lone Mtn
Mt Meek
Roberts Peak
Sheep Mtn
Green Mtn
Mt Troy
Thane
Colt Island
Horse Island
Hawthorne Pk
Middle Pk
Funter
Clear Pt
Funter Station
Middle Pt
Mt Bradley
West Pk
Dupont
PASSAGE
Robert Barron Peak
McDonough Pk
Peninsula
Pt Hilda
GREATER JUNEAU BOROUGH
Pt Salisbury
Bishop Pt
Marmion I
Scull Island
Pt Young
Young Bay
Admiralty Cove
False Arden
Pt Arden
Green Cove
STEPHENS
Hawk Inlet
FOREST
Young Lake
Glass Peninsula
Cove Pt
Eagle Peak
Grand Island
Hawk Pt
Gambier Bay
Pt Marsden
Pt Augusta
CHATHAM STRAIT
ADMIRALTY ISLAND
SEYMOUR
1
2

JUNEAU, ALASKA

SCALE 1:250,000

JUNEAU - DOUGLAS AREA

I. INTRODUCTION

The purpose of this summary is to examine and evaluate the sources and extent of pollution in the Juneau-Douglas Area and to recommend actions designed to satisfy immediate needs.

The Cities of Juneau and Douglas presently discharge their raw sewage to Gastineau Channel through numerous outfalls. Except for three small package treatment plants in the Mendenhall Glacier Area, all other raw sewage from this area is discharged to the ground via septic tanks or cesspools, or to local bodies of water.

These practices are inconsistant with the Alaska Water Pollution Control Act and the State Administrative Code. The State Department of Health requires that a minimum of primary treatment be given to sewage discharged to surface waters.

In addition to State requirements, Presidential Executive Order 11288 requires Federal Installations to provide secondary treatment for all wastes, except cooling water and fish hatchery wastes, or preferentially, to discharge wastes into a municipal sewer system providing adequate treatment.

No detailed study was made in the preparation of this summary. A complete engineering design analysis will be required prior to physical implementation of the recommendations presented herein.

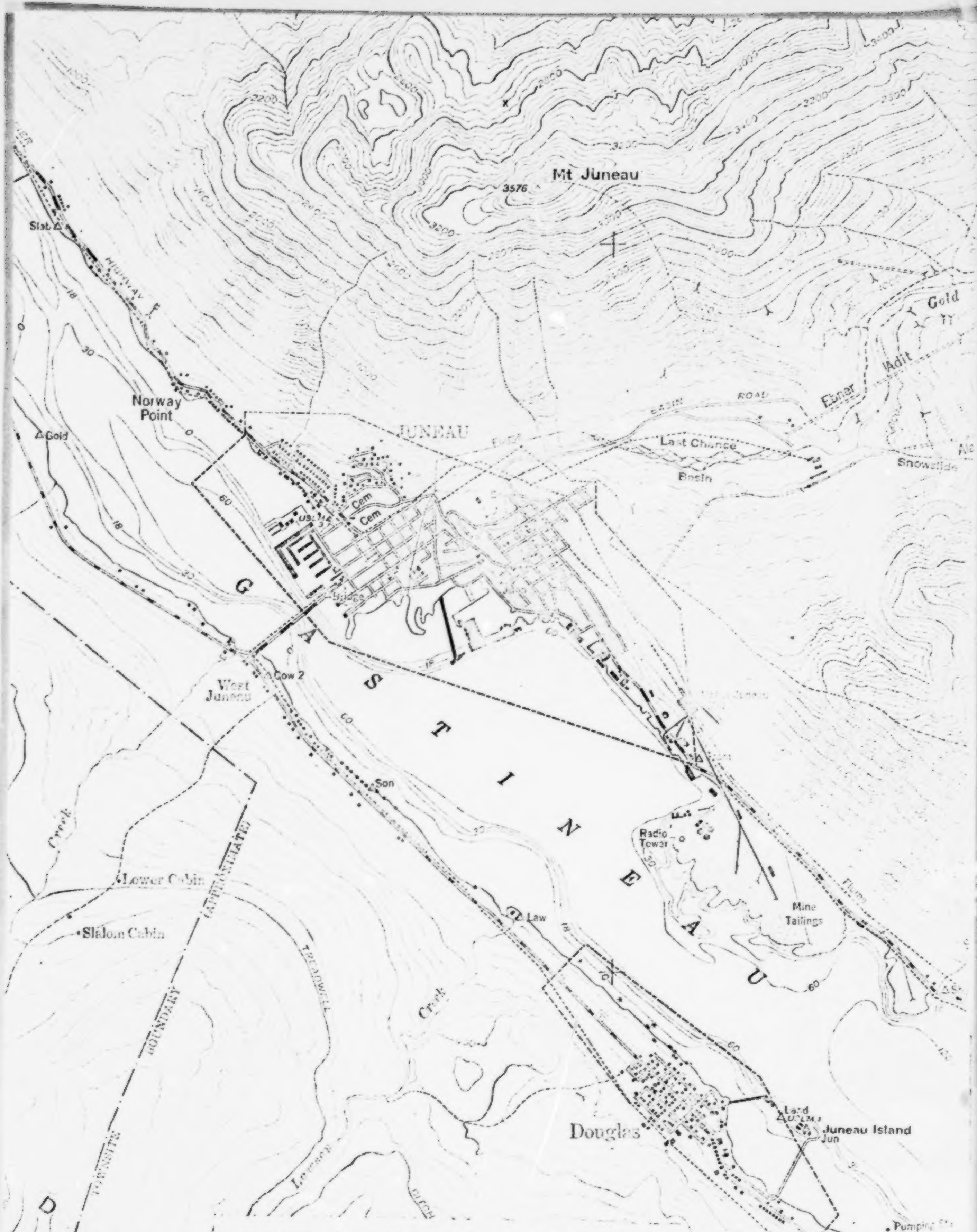
II. SUMMARY OF MAJOR POLLUTION PROBLEMS, COSTS OF ABATEMENT, AND RESPONSIBLE AGENCIES

Responsible agency and nature of waste	Immediate treatment needs	Estimated cost to correct	Relative Priority	Vicinity Map Index
City of Juneau (domestic wastes)	Primary treatment and disinfection	$400,000 (improvements to existing system only)	(A)	1

Responsible agency and nature of waste	Immediate treatment needs	Estimated cost to correct	Relative Priority	Vicinity Map Index
City of Douglas (domestic wastes)	Primary treatment and disinfection	$500,000 (improvements to existing system only)	(A)	2
	Primary treatment plant for cities of Juneau and Douglas	$2,600,000 (interceptors and plant only)	(A)	
		$3,500,000 (total cost of combined improvements)		
Greater Juneau Borough, Mendenhall Glacier Valley Area (domestic wastes)	Primary treatment and disinfection	$1,500,000	(A)	3
One privately owned seafood processing plant. (Seafood wastes)	Separation of solids at plant. Disposal of liquids to Municipal Sewer. Dispose of solids by solid waste disposal methods.	Capital cost included in municipal system costs above.	(B)	1
Small Boat Harbor (domestic wastes)	Primary treatment and disinfection (connect to municipal system)	$50,000	(B)	1

III. IMMEDIATE CONTROL NEEDS

The Juneau-Douglas Area economy is based mainly on government disbursements, with about 50 percent of the civilian workforce employed by the federal, state or local government. Tourism and seafood processing also contribute to the economy. There is recreational use of the waters of Gastineau Channel, Auke Lake and the clearwater streams associated with these systems. Recreational boating and fishing are very popular. For the most part, municipal and private water supplies are free from pollution; however, potable water supplies in the Mendenhall Glacier Valley Area originate in ground water aquifers and are subject to contamination from sewage discharged from cesspools and septic tanks.


Mt Juneau
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Bridge
Basin Road
Last Chance
Basin
Ebner
Adit
Gold
Snowslide
G A S T I N E A U
West Juneau
Cow 2
Son
Radio Tower
Mine Tailings
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JUNEAU AND VICINITY, ALASKA

The continued discharge of untreated pollutants into the surface waters and aquifers of the Juneau-Douglas Area can be expected to increase the hazard of using ground water supplies. Untreated sewage can also be expected to lead to the continued deterioration of the surface waters and shore areas, by creating potential health hazards, and aesthetic and nuisance problems.

In order to abate the existing pollution conditions in the Juneau-Douglas Area the following immediate steps are recommended, in order of relative priority.

A. Construct a primary treatment plant(s) and interceptor sewers, so that municipal sewage from the Cities of Juneau and Douglas will not impare the water quality of Gastineau Channel.

B. Construct a primary treatment plant and sewer system in the Mendenhall Glacier Valley Area.

C. Screen seafood processing plant wastes and discharge to municipal sewers, or waters which will provide adequate dilution. Dispose of solid wastes in accordance with acceptable solid waste disposal practices.

D. Construct a sewer system for the small boat harbor and discharge into the municipal system.

IV. RECENT PROGRESS IN POLLUTION CONTROL

The Juneau-Douglas Area has been cognizant of the dangers of pollution for some time and various steps have been taken during the past several years to analyze the problem.

During 1961 a report entitled "Proposed Street and Sewer Improvements for the City of Juneau, Alaska" was prepared by Wyller, Van Doren and Hazard, consulting engineers. During 1962 a similar report was prepared by the same firm for the City of Douglas. Treatment was not envisioned in either report.

In June 1964, the State Department of Health and Welfare published a report entitled "Sanitary Facilities for the Greater Juneau Borough" which exemplified the need for additional engineering studies for the Mendenhall-Glacier Valley Area.

In July 1965, the Alaska State Housing Authority prepared a report entitled "Comprehensive Plan for Juneau, Alaska", which touched on the problems of waste disposal, and emphasized the need for treatment facilities.

The "Streeter Report" published by the FWPCA in July 1966, and entitled "Oceanographic and Related Water Quality Studies in Southeastern Alaska, August 1965" was the result of a voyage which studied water circulation, salinity, dissolved oxygen, PH, and bacterial quality in Gastineau Channel.

The consulting firm of Hill and Ingram, are presently supplementing the Streeter Report by a more detailed survey of bacteriological contamination of Gastineau Channel.

Three small package treatment plants have been constructed recently in the Mendenhall-Glacier Valley Area. These serve the Municipal Airport, the Glacier Valley School, and a subdivision. These plants represent a definite improvement over previous methods of disposal, and indicate a growing awareness of the dangers of pollution in the community.

V. BACKGROUND FOR RECOMMENDATIONS

A. Pertinent Basin Characteristics

1. Geography

The Juneau-Douglas Area is located in the Southeastern Alaska panhandle 900 miles northwest of Seattle and 75 miles from the open Pacific Ocean. For the most part, the Juneau Area has developed along the Gastineau Channel and encompasses approximately 25 square miles. Juneau, the capitol city of Alaska, is situated at the base of 3,500 foot Mt. Juneau; in front is Gastineau Channel, and to the north and south the fingers of the mainland ice field reach to the fjord-cut coast. Gastineau Channel separates Juneau from the smaller residential City of Douglas. The two are connected by a bridge and short highway. Thane to the south and the Mendenhall Valley to the north, generally outline the remaining geographical boundries.

2. Climate

The Juneau-Douglas Area has a mild but moist climate as does all Southeast Alaska. The weather station at the Juneau Airport reports an annual mean temperature of 40.6° F., January mean 26.2° F. and the July mean 54.7° F. Annual rainfall is 55.94 inches with the spring and early summer having the lighter monthly total. Snowfall annual total is 92.1 inches, however, alternating rain and snow prevent a heavy accumulation. The highest temperature recorded was 84 and the lowest -21.

3. Population

In 1960 the Juneau election district had a population of 9,745. Since 1960, the population of the area has increased 27.4 percent to 12,418. The growth, which is the result of increased government employment, immigration and Alaska's high rate of natural increase, is taking place in Juneau's suburbs rather than within the city limits of Juneau or Douglas.

4. Industry

Principal payrolls are from government activities, and fishing. Government employment has been the most important part of Juneau's total employment, comprising about 50 percent. Summer visitors, mining, transportation and trade add to the economy. Approximately 30 percent is in distributive industries, including transportation, communications, and public utilities; trade; and finance, insurance and real estate; and service. Only 9 percent are in the commodity-producing industries of mining, construction, and manufacturing.

5. Streams and Rivers

Six small streams enter Gastineau Channel within the Juneau-Douglas Area and produce small numbers of pink and chum salmon. Although they are closed to salmon fishing, the younger generation actively participates in sportfishing for Dolly Varden char. Salmon Creek Reservoir provides good eastern brook trout fishing. Mendenhall River originates from Mendenhall Glacier, and Mendenhall Lake. It flows through a broad, flat valley for a distance of about 5 miles and discharges into tidewater near the Juneau Airport. The river is very turbid during summer glacial melt period. The river is an important migration route for sockeye salmon seeking clearwater tributaries entering Mendenhall Lake. Montana Creek enters Mendenhall River from the northwest and supports a good run of chum salmon and Dolly Varden char. Auke Lake and Creek contains a sizeable run of sockeye salmon. Pink salmon use the lower reaches of Auke Creek for spawning. The sportfish in this system include Dolly Varden char and Cutthroat trout.

6. Vegetation

The vegetation surrounding Juneau is comprised of hemlock and Sitka spruce in the lowlands and hillsides up to 2,000 feet. Sparce cedar stands are found in lowlands. Alder predominates near stream banks and hillsides devoid of conifers. Grass and sedge occupy lowlands and saltwater marsh areas. Owing to the high annual rainfall, vegetation grows to form dense rainforest cover, quite similar to those found along the northern coast of Washington and Vancouver Island.

B. Present Water Quality Problems

The cities of Juneau and Douglas discharge untreated domestic sewage directly to Gastineau Channel. Evidence of bacteriological contamination was presented in the Streeter Report (see following pages). The discharge of untreated wastes to the waters of Gastineau Channel also leads to objectionable odors and to the presence of floating solids along the shoreline. Moreover, the raw sewage discharge is not consistant with either the Alaska Water Pollution Control Act or the State Administrative Code. At least primary treatment is required by the State Department of Health.

Outside the municipal sewer systems, sewage is either dumped directly into watercourses, or piped to septic tanks or cesspools. Pollution from Mendenhall Valley homes has been detected in semi-public water supplies by the Borough Sanitarian. During February 1967, 17 percent of the samples taken were positive. It is expected that the frequency will increase as the area is further developed. Some attention has been given to pollution abatement through the installation of three small package treatment plants.

All seafood processing for the Juneau area is handled by one company. Waste products are discharged directly to Gastineau Channel and constitute a source of added organic load during the summer months. Decomposition of organics cause objectionable odors and depressed oxygen conditions, unfavorable to fishlife. Lack of industrialization and forecasts for increased government activities limit the main pollution problems to treatment of domestic sewage.

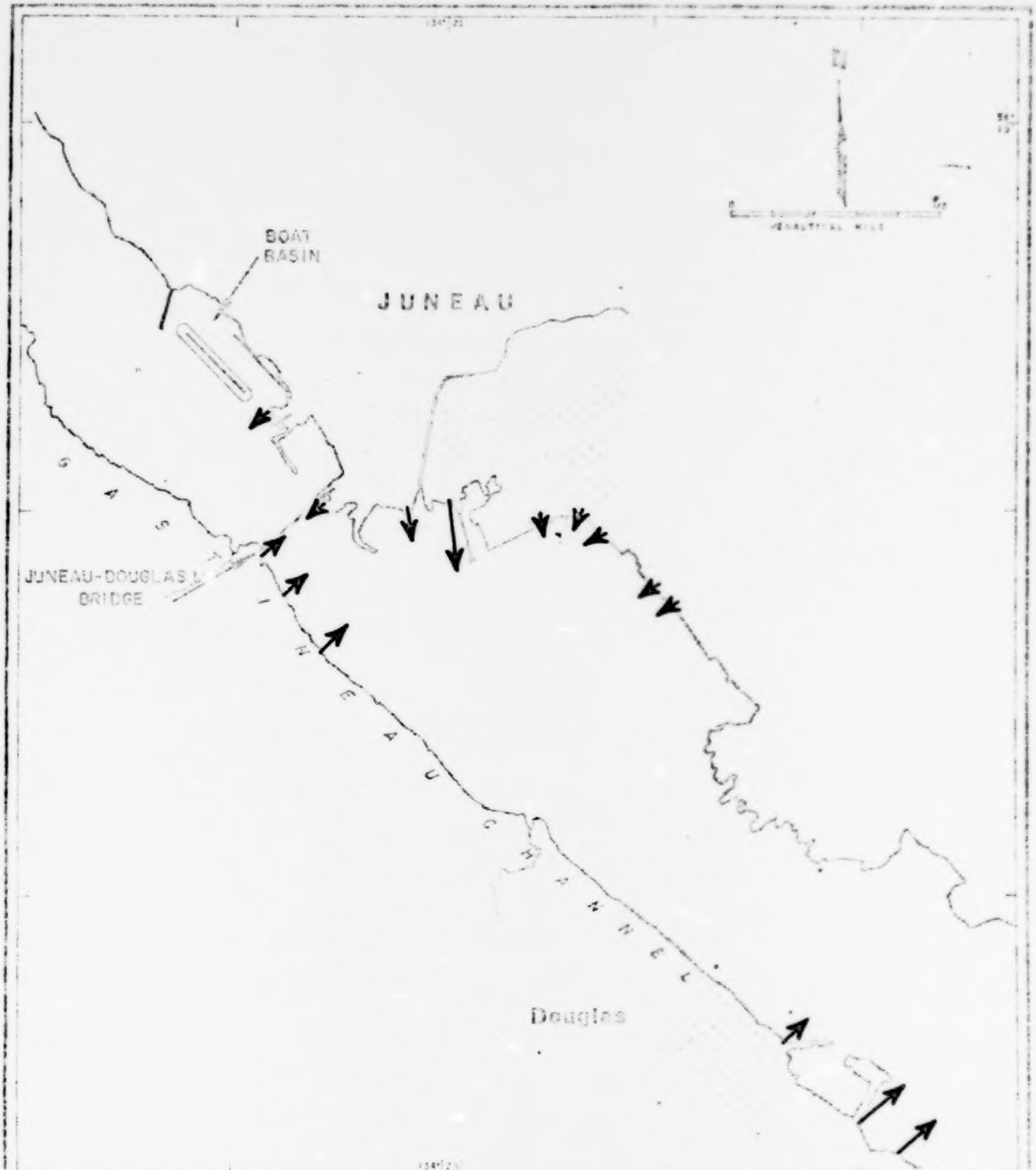
134°25'
BOAT BASIN
JUNEAU
GASTINEAU CHANNEL
JUNEAU-DOUGLAS BRIDGE
Douglas
0
NAUTICAL MILE
134°25'

FIGURE 1-4. Raw sewage outfall locations; information provided by State of Alaska, Department of Health and Welfare.

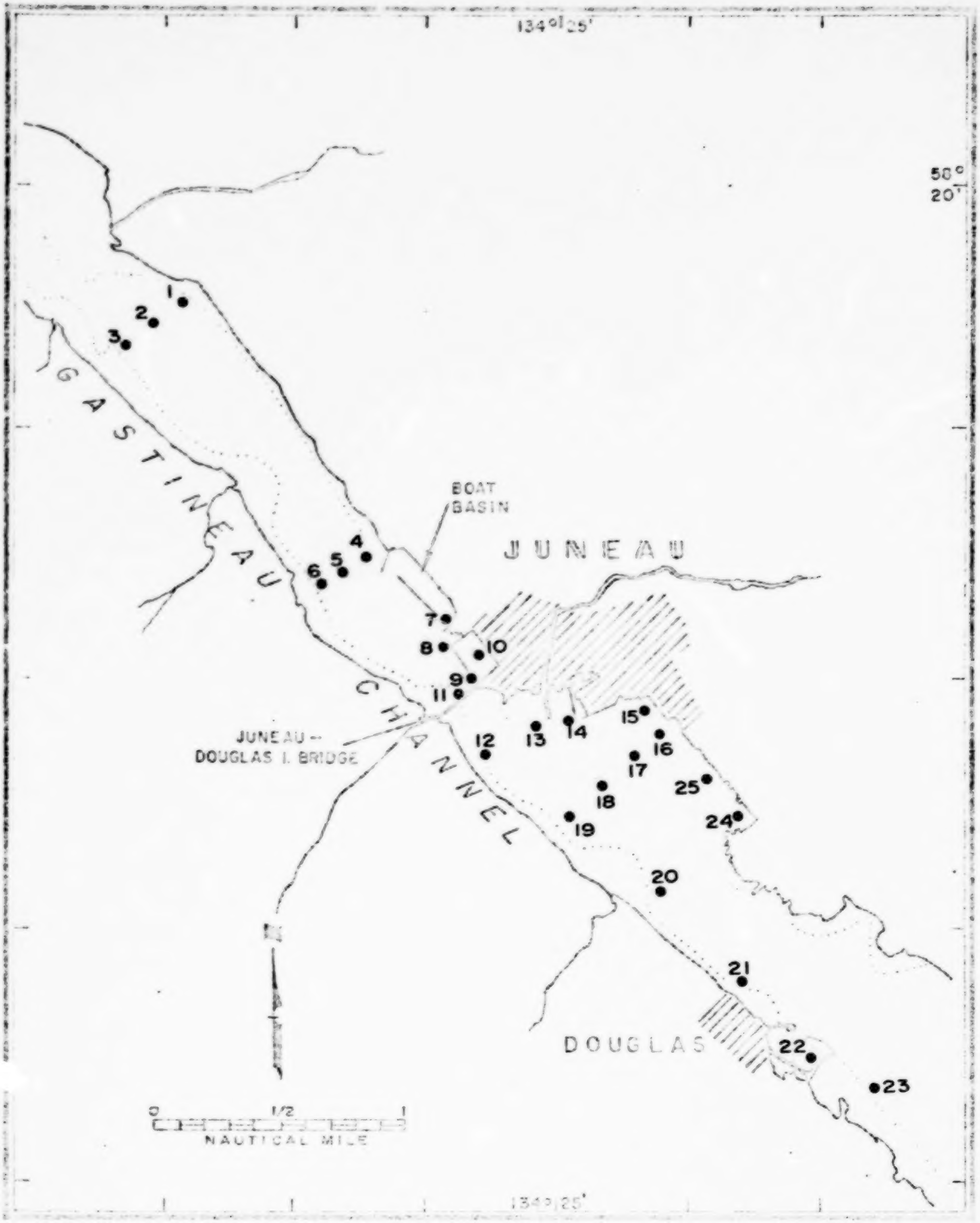
134°25'
58°
20'
1
2
3
GASTINEAU CHANNEL
BOAT BASIN
JUNEAU
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
JUNEAU -- DOUGLAS I. BRIDGE
DOUGLAS
0
1/2
1
NAUTICAL MILE
134°25'

FIGURE 1-3. Bacteriological sampling locations - August 23, 1965.

BACTERIOLOGICAL RESULTS
August 23, 1965

Sampling Station	MPN's per 100 ml
1	240
2	240
3	240
4	240+
5	240
6	240+
7	380
8	240+
9	2,400+
10	2,400
11	2,400+
12	2,400+
13	150
14	88
15	2,400
16	2,400
17	15
18	2
19	240+
20	38
21	2,400+
22	2,400
23	960
24	240+
25	150

Auke Lake provides the water supply for the U S Fish and Wildlife Services, Biological Laboratory. Uncontaminated fresh water is a requirement for their aquatic experiments Wells supplying fresh water for domestic use have become saltwater contaminated and the Laboratory plans to convert to Auke Lake water for primary supply.

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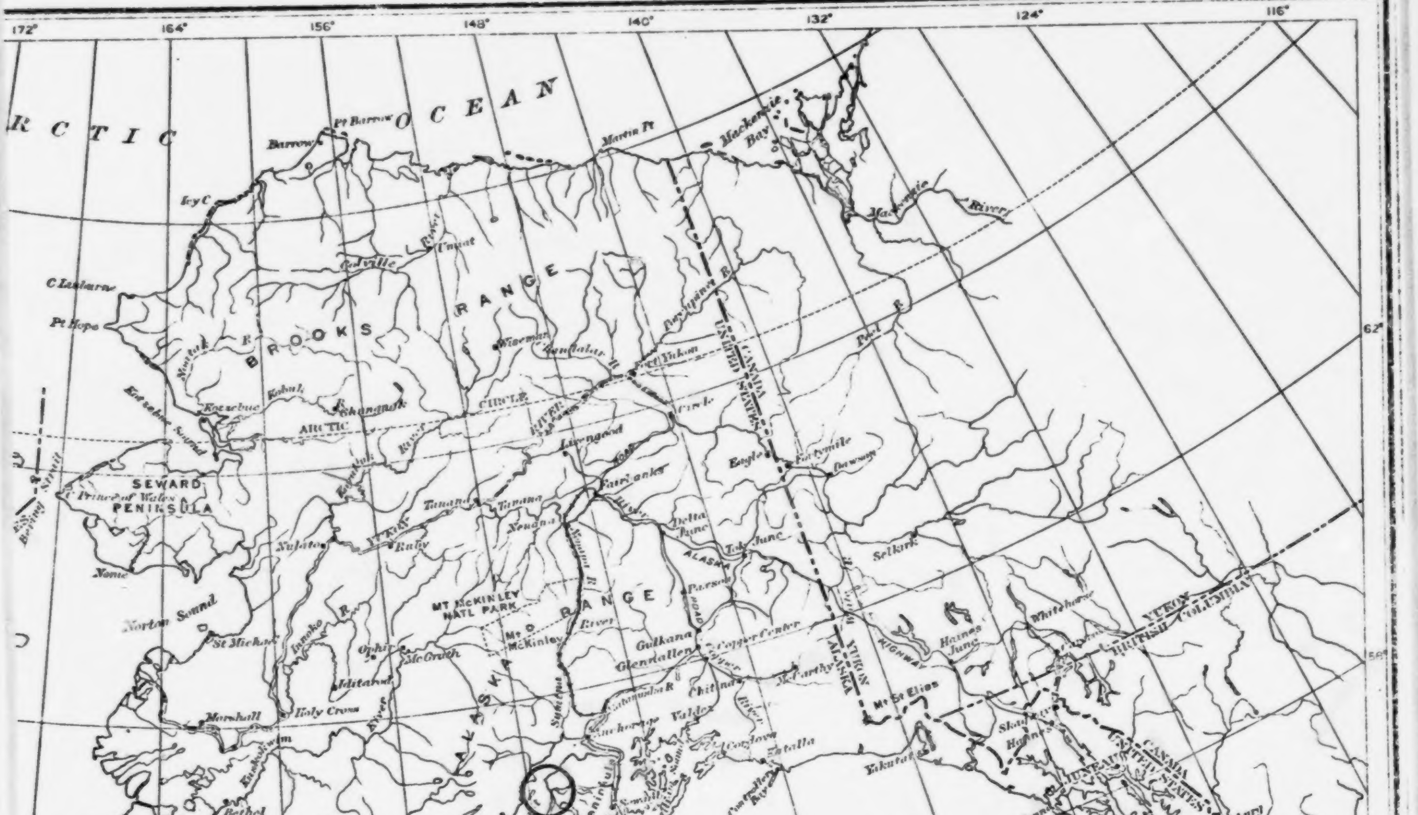
KENAI-SOLDOTNA AREA

ALASKA

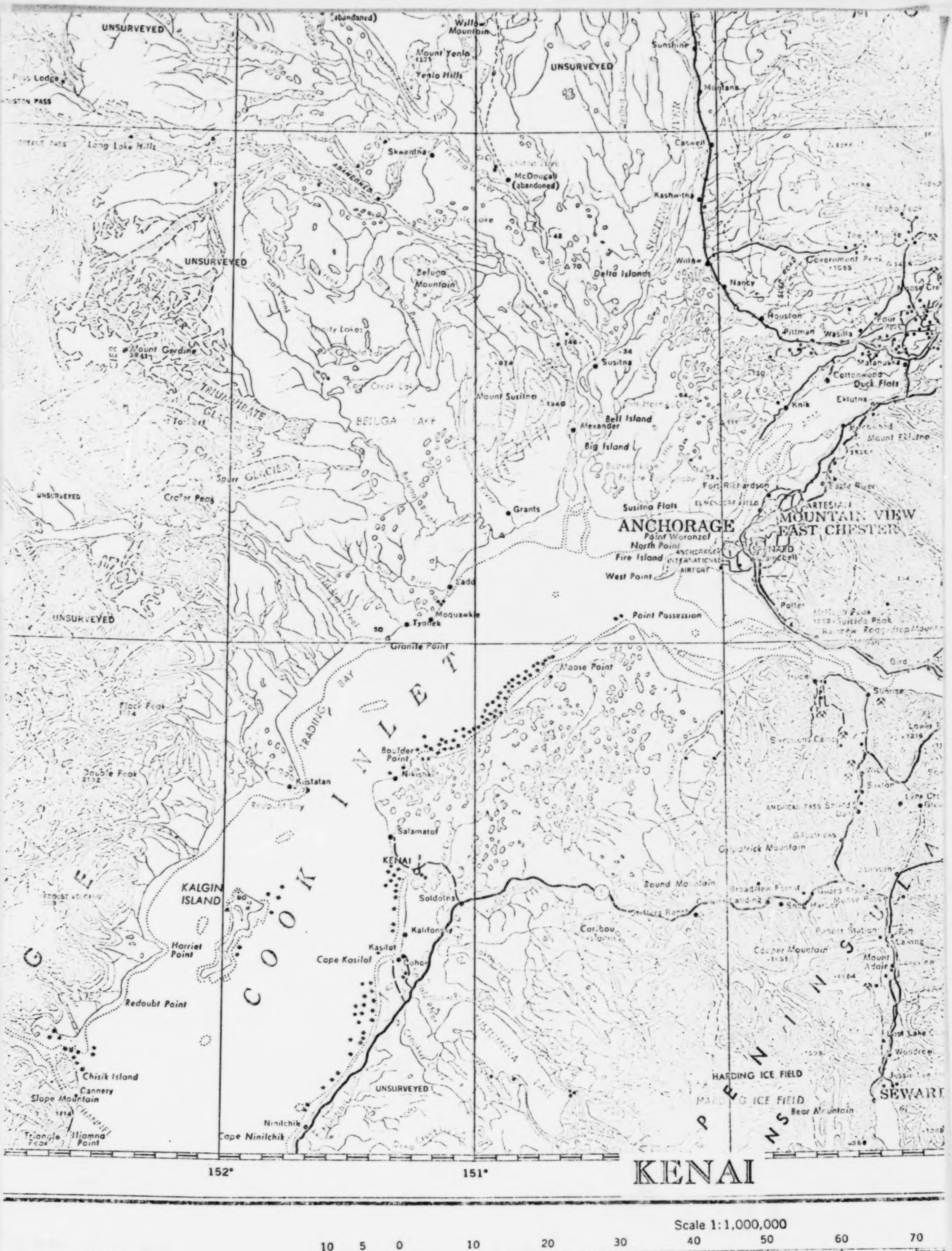

KENAI-SOLDATNA AREA
ARCTIC OCEAN
PACIFIC OCEAN
GULF OF ALASKA
BROOKS RANGE
ALASKA RANGE
ARCTIC CIRCLE
SEWARD PENINSULA
ALASKA PENINSULA
MT McKINLEY NATL PARK
Mt McKinley
Barrow
Pt Barrow
Nome
Fairbanks
Anchorage
Valdez
Cordova
Kodiak
Juneau
Sitka
Bristol Bay
Cook Inlet
Shelikof Strait
Norton Sound
Kotzebue Sound
Yukon River
Mackenzie River
Shumagin Is
Unimak
Dutch Harbor
Unalaska I
CANADA
UNITED STATES
YUKON
BRITISH COLUMBIA
172°
164°
156°
148°
140°
132°
124°
116°
160°
152°
144°
136°
62°
58°
54°
50°
0
100
200
300
400
500 Miles
500 Kilometers

INTERIOR—GEOLOGICAL SURVEY WASHINGTON, D. C. 1957

ALASKA, MAP C

BY U. S. GEOLOGICAL SURVEY, FEDERAL CENTER, DENVER, COLORADO OR WASHINGTON 25, D. C

4.2


KENAI
Scale 1:1,000,000
10 5 0 10 20 30 40 50 60 70
152°
151°
COOK INLET
KENAI PENINSULA
ANCHORAGE
MOUNTAIN VIEW
EAST CHESTER
UNSURVEYED
Willow Mountain
Mount Yenlo
Yenlo Hills
Sunshine
Montana
Caswell
Long Lake Hills
Skwentna
McDougall (abandoned)
Kashwitna
Willow
Nancy
Houston
Pittman
Wasilla
Government Peak
Beluga Mountain
Delta Islands
Susitna
Mount Gerdine
Mount Susitna
Alexander
Bell Island
Big Island
Knik
Cottonwood
Duck Flats
Eklutna
Matanuska
TRIUMVIRATE GLACIER
BELUGA LAKE
Spurr GLACIER
Crater Peak
Grants
Susitna Flats
Fort Richardson
Point Woronzof
North Point
Fire Island
West Point
ANCHORAGE INTERNATIONAL AIRPORT
Ladd
Moquawkie
Tyonek
Granite Point
Point Possession
Potter
Moose Point
TRADING BAY
Black Peak
Double Peak
Boulder Point
Nikishki
Kustatan
Redoubt Bay
Salamatof
KENAI
KALGIN ISLAND
Soldotna
Kalifonsky
Kasilof
Cape Kasilof
Cohoe
Harriet Point
Redoubt Point
Chisik Island
Cannery
Slope Mountain
Triangle Peak
Iliamna Point
Ninilchik
Cape Ninilchik
Round Mountain
Caribou Island
Gilpatrick Mountain
Cooper Mountain
Mount Adair
Sunrise
Hope
Sterling
Moose Pass
HARDING ICE FIELD
Bear Mountain
Lost Lake
SEWARD
Suicide Peak
Eagle River
Mount Eklutna
Sutton
Four Corners

KENAI-SOLDOTNA AREA

I. INTRODUCTION

The purpose of this summary is to examine and evaluate the sources and extent of pollution in the Kenai-Soldotna area and to recommend actions designed to satisfy immediate needs.

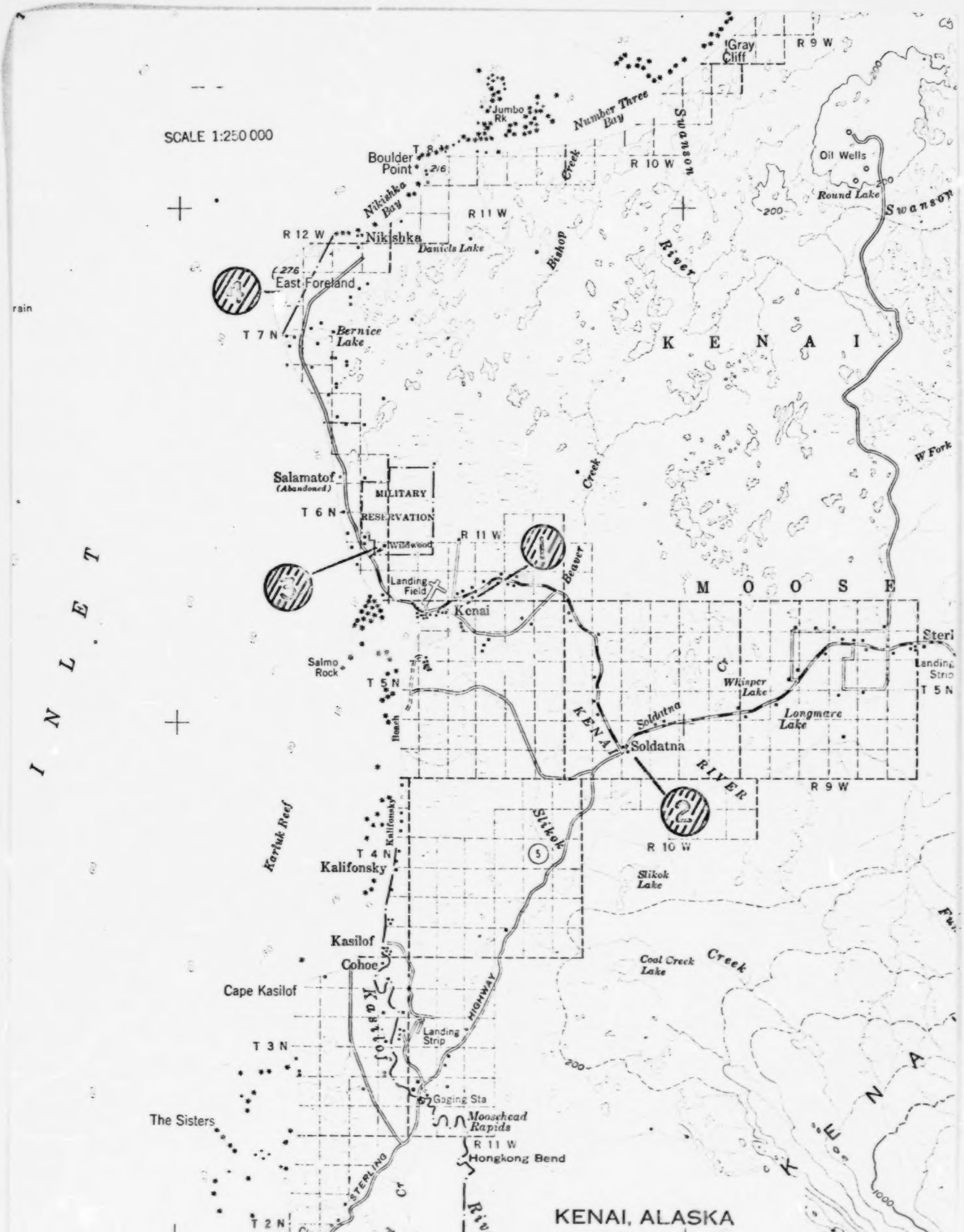
Due to the recent discovery and commercial production of oil and gas, there is a greatly increased potential for accelerated economic development in the area, with associated industrial waste and domestic sewage problems. An oil refinery was recently built, and a urea plant is presently under construction. Advance planning is also underway for a cryogenics plant to be built nearby.

The City of Kenai presently operates a small primary treatment plant which serves portions of the City of Kenai.[1] The balance of the area discharges raw sewage directly into the Kenai River and Cook Inlet or to septic tanks and cesspools connecting directly to groundwater supplies.

These practices are in violation of the Alaska Water Pollution Control Act and the Administrative Code. The State Department of Health and Welfare requires that a minimum of primary treatment be given to sewage discharged to surface waters.

In addition to state requirements, the Presidential Executive Order 11288 requires federal installations to provide secondary treatment for all wastes except cooling waters and fish hatchery wastes, or preferentially, to discharge wastes into municipal sewer systems providing adequate treatment..

No detailed studies were made in the preparation of this summary. A presumption, was made that a complete Engineering Design Analysis will preclude physical implementation of these recommendations.


SCALE 1:250 000
Gray Cliff
R 9 W
Jumbo Rk
Number Three Bay
Swanson
Boulder Point
T 8
216
R 10 W
Oil Wells
Round Lake
Swanson
200
Nikishka Bay
R 11 W
Creek
Bishop
R 12 W
Nikishka
Daniels Lake
River
276
East Foreland
4
T 7 N
Bernice Lake
K E N A I
W Fork
Salamatof
(Abandoned)
MILITARY RESERVATION
T 6 N
Wildwood
R 11 W
1
Creek
3
Landing Field
Beaver
Kenai
M O O S E
Sterl
Landing Strip
T 5 N
Salmo Rock
T 5 N
Whisper Lake
Longmare Lake
Beach
Soldatna
KENAI
Soldatna
RIVER
R 9 W
2
R 10 W
I N L E T
Karluk Reef
Kalifonsky
Slikok
5
T 4 N
Kalifonsky
Slikok Lake
Kasilof
Cohoe
Coal Creek Lake
Creek
Cape Kasilof
Kasilof
HIGHWAY
Landing Strip
T 3 N
200
Gaging Sta
Moosehead Rapids
The Sisters
R 11 W
Hongkong Bend
STERLING
T 2 N
Riv
1000
K E N A
KENAI, ALASKA

II. SUMMARY OF MAJOR POLLUTION PROBLEMS, COSTS OF ABATEMENT, AND RESPONSIBLE AGENCIES.

Responsible Agency & Nature of Waste	Immediate Treatment Needs	Estimated Cost to Correct	Relative Priority	Vicinity Map Index
Cities of Kenai, Soldotna & environs (Domestic Wastes)	Connection to modified Kenai primary treatment plant or construction of community collection and treatment facilities.	$1,000,000 (+)	(A)	1,2
Wildwood Air Force Station (Domestic Wastes)	Secondary treatment (or connection to Kenai city sewer)	100,000 (for secondary treatment)	(A)	3
Two privately owned fish canneries (Fish Wastes)	Separation of solids and discharge of liquid wastes to adequate dilution water.	*	(A)	1
Privately owned oil refinery (Oil Wastes)	Oil separators.	No estimate made	(B)	4
Proposed urea plant and proposed cryogenic plant (Industrial Wastes)	No immediate treatment needs as design of plants should have abatement provisions built in.	No separable cost	(C)	4

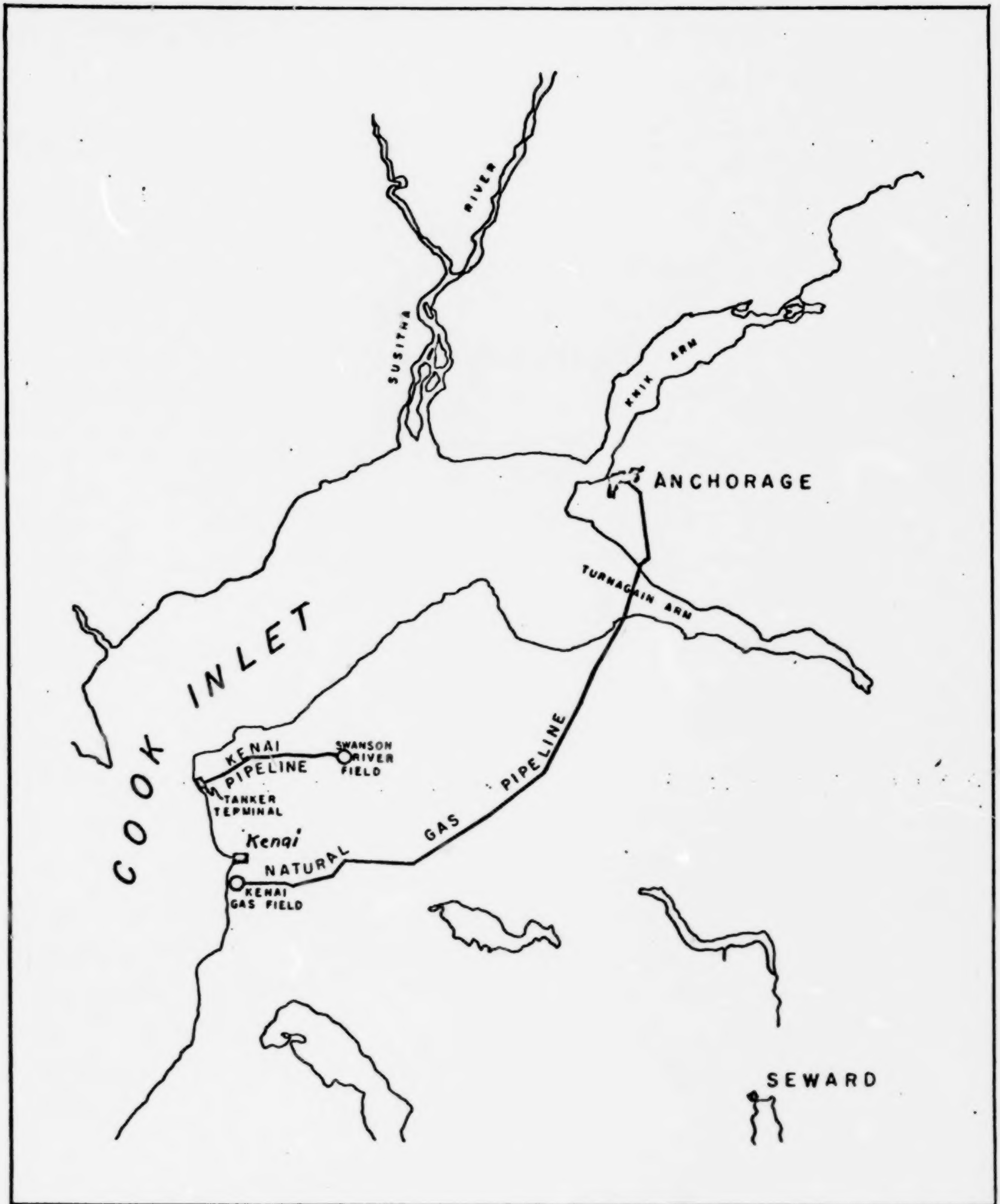
(+) This is a rough estimate for the purposes of this report. A feasibility study would be required to determine whether a single system or separate systems are apropos.

* The estimated cost to correct would be included in the cost of a municipal interceptor system.

III. IMMEDIATE CONTROL NEEDS

The Kenai-Soldotna area is one of the most rapidly developing portions of the State due to the recent commercial production of oil and gas nearby. The recent completion of an oil refinery, the present construction of a urea plant, and the planned construction of a cryogenics plant indicate a potential for a highly industrialized development of the entire surrounding area.

Prior to the discovery and commercial production of oil and gas, the main industry was the canning of salmon. Two canneries


SUSITHA
RIVER
KNIK ARM
ANCHORAGE
TURNAGAIN ARM
COOK INLET
KENAI
PIPELINE
SWANSON
RIVER
FIELD
TANKER
TEPMINAL
Kenai
NATURAL
GAS
PIPELINE
KENAI
GAS FIELD
SEWARD

PIPELINE ROUTES

ALASKA OIL AND GAS YEARBOOK — 1960

SCALE 1" = 16 MILES

are presently situated on the Kenai River, and canning will probably remain an important industry.

Kenai is also near the center of one of the largest migration routes for anadromous fish in Alaska, and the continued discharge of untreated pollutants into these waters can be expected to cause the eventual depletion, both in quantity and quality of the valuable resource. Nearby razor clam beds can also be expected to be adversely affected. The discharge of this untreated sewage and fish waste also leads to deterioration of the waters of the Kenai River and shore areas immediately surrounding Kenai, creating potential health hazards and leading to aesthetic, odor, and nuisance problems. The probable continued viability of pathogens in the cold and rapidly moving waters of Cook Inlet greatly increase the potential for the widespread distribution of waterborne diseases.

The widespread use of septic tanks and cesspools has led to an increasing frequency of bacterial pollution in groundwater and has caused much concern since most potable water supplies in the Kenai-Soldotna area originate in shallow wells. This practice can only add to the existing hazard and increase as the area is developed for residential use.

In order to abate the existing pollution problem in the Kenai-Soldotna area, the following immediate steps are recommended, in order of priority:

A. (Alternate 1)

Construct interceptor and trunk sewers to connect the Kenai City treatment plant with the suburban areas.

(Alternate 2)

Construct separate collection and package-type treatment systems for individual population and commercial centers.

(A project to install an aerated lagoon at Wildwood Air Force Station is presently contemplated. Estimated cost is about $100,000.)

The choice between these two alternates would be contingent on the results of a detailed engineering study comparing the relative costs of each. Cost of such a study is estimated at about $10,000.

B. Terminate the present practice of disposing of cannery wastes by direct discharge to the Kenai River. Disposal of solids should be in accordance with acceptable solid waste disposal practices.

IV. RECENT PROGRESS IN POLLUTION CONTROL

The City of Kenai recently constructed a primary sewage treatment plant and collection system which serves the core area of the city, but does not serve outlying areas or the two canneries. The treatment plant is an 18' "Spiragester", detailed in Lakeside Engineering Corp. Bulletin No. 136.[1]

The Kenai Peninsula Borough Sanitarian is monitoring the bacterial quality of potable groundwater supplies and Borough records attest to the need for cessation of discharge of cesspool and septic tank effluent to groundwater aquifers.

Wildwood Air Force Station is presently programming an aerated lagoon for the treatment of sewage.

Aside from the foregoing there are no known definitive plans for the abatement of pollution in the Kenai-Soldotna Area.

V. BACKGROUND FOR RECOMMENDATIONS

A. Pertinent Basin Characteristics

1. Geography

The Kenai-Soldotna area is located in a generally flat section of the central-west coastal region of the Kenai Peninsula. (See map.) The geographical area comprises approximately 150 square miles and includes two principal population centers, Kenai and Soldotna. These cities are served by the Sterling Highway, whereby all weather road affords links to Homer, Seward, and Anchorage.

2. Topography and Geology

Kenai Peninsula is comprised of two geophysically and geologically dissimilar districts. These are the Kenai Mountains which make up the largest portions of the eastern and southern parts and the Kenai Lowland which makes up the western part. The eastern area is mountainous with peaks rising to 6,000 feet. The Lowlands are from sea level to about 2,000 feet. The Kenai-Soldotna area is located in the Lowlands.

3. Climate

The climate of the Kenai-Soldotna area is characterized by cool summers and relatively mild winters, compared to interior Alaska. The Kenai Mountains to the east rise abruptly to 5-6,000 feet and prevent warm moist Pacific Ocean air from entering the area in any direction except the southwest. Consequently, although Kenai is located on an arm of the Pacific Ocean, its climate is more continental than marine.

The average annual rainfall, based on standard normals for the period 1931-1960, is 19.03 inches. Precipitation is light in the winter with increasing storm frequency during spring and summer. Maximums are reached in September. Slightly more than 46 per cent of the mean annual precipitation falls during the 3-month period, July through September.

Seasonal snowfall is about five feet. Mean annual temperature is 33.3° F., while the lowest ever recorded was -48° F. during February 1947. The highest ever recorded was 89° F. in September 1883. Temperatures above 80° F. are uncommon. A frost free season of 90 days can be expected between May and the latter part of August.

4. Population

The population of the Kenai-Soldotna area is about 5,000. This is a five-fold increase over the reported 1,000 in 1960. The large increase can be attributed to the development of the oil industry. By 1980 nearly 15,000 people are anticipated to be living in the Kenai-Soldotna area.

5. Industry

Fishing and oil, in that order, are the chief industries of the area. Beginning in 1957 when oil was first discovered by Richfield Oil Company in the Swanson River field north of Kenai, exploration, development, production, refining and shipping have proceeded at a steady pace. A natural gas pipeline, constructed in 1961, connects wells located six miles south of Kenai with Anchorage. Oil is refined by Standard Oil Company into jet fuel, diesel, and stove oil a few miles northwest of Kenai at Nikiski. New construction includes an ammonia - urea, fertilizer complex. A gas liquification plant is contemplated in the near future. All forecasts include Kenai-Soldotna to be the hub of oil activities for the Kenai Peninsula and offshore Cook Inlet.

6. Streams and Rivers

Kenai River and tributaries are the only streams of consequence to be considered in this report. The Kenai River originates from Kenai Lake, flows through Skilak Lake, and then continues across the Lowland discharging into Cook Inlet at the City of Kenai. The river drains 2,000 square miles and is the largest and most important river on the Kenai Peninsula. A maximum discharge of 16,000 cfs has been recorded during September at Soldotna. No winter minimums are listed in the flow data.

The Kenai River is turbid during ice free months owing to glacial silt. The river clears in the winter when glacial melt is reduced.

Chinook, coho, pink, and sockeye salmon ascend Kenai River to spawning grounds. The river system is known to support the largest salmon runs on the Kenai Peninsula, and except for the Susitna River, may be the largest producer in Cook Inlet. Compared to the total salmon caught by commercial fishermen in Cook Inlet during 1966, more than half were from the vicinity of Kenai. Although drift gillnets provide the largest effort, set gillnets along beaches in the Kenai area contribute a substantial catch.

Besides being important to commercial fishermen, the Kenai River supports an intensive sportsfishery. Dolly Varden char, rainbow trout and whitefish are taken by anglers year round. Boating is popular in the river section between Soldotna and Kenai. Two small tributaries, Soldotna Creek and Beaver Creek, contain Dolly Varden and rainbow trout. These streams are popular with young anglers and will continue receiving heavy use as access is improved. The Alaska Department of Fish and Game places high value on these streams for a coho salmon rearing area.

The Kenai River is under study by the State Department of Health and Welfare in a program of describing streams and rivers which are within the realm of becoming polluted. The Kenai River receives raw domestic sewage from permanent residences and businesses at Soldotna and Kenai. Should the trend continue, the value of the river for commercial and recreational use will be impared.

B. Present Water Quality Problems

1. Domestic Pollution Sources

At the present time domestic sewage from the following areas is being discharged directly into the Kenai River or Cook Inlet through numerous small outfalls.

a.	City of Kenai	30,000 gpd.
b.	Kenai High School	3000 gpd.
c	Momsen Subdivision	1500 gpd.
d.	Soldotna Dry Cleaning Plant	unknown
e.	River Terrace Trailer Court	unknown
f.	Concrete Block Plant	unknown
g.	An estimated 30 to 50 homes in the Soldotna Area discharge raw sewage directly to the Kenai River.	unknown
h.	Wildwood Air Force Station	35,000 gpd.

The balance of the area discharges sewage through septic tanks or cesspools which drain into the groundwater supply. Aside from bacteriological tests which indicated unsatisfactory quality, an outbreak of infectious hepatitis, nearing epidemic proportions, was recorded in 1963.

2. Cannery Wastes

During the fishing season the canneries dispose of fish waste by direct discharge into the lower Kenai River. About 1/3 of the total catch is estimated to be waste. In 1962 the amount of this waste was about 54,000 pounds per day, equivalent to about

21,000 lbs. B.O.D. (5 day 20° C). Associated vessel operations additionally discharge spoiled fish, untreated sewage, and bilgewater near the canneries.

When added to the natural pollution load of spawned out dead salmon, estimated to average about 21,000 lbs. of B.O.D. per day, the results are very noticeable! A count by an engineer revealed salmon heads at about a 10 foot spacing and whole spawned out salmon at a spacing of 50', along the beach at the north side of the entrance to Kenai River. The odor is not as severe as would be expected in a warmer climate however.

Due to cold water temperatures, the closeness of the canneries to Knik Arm, (where a high dilution factor is available), and the large size of fish particles, the full B.O.D. of this waste would not be expected to be exerted on the Kenai River. Consequently, dissolved oxygen levels may not have fallen to the extent of affecting the salmon run, although this assumption should be verified by field testing.

If, as at Kodiak, local ordinance required the grinding of wastes before discharge, the consequent increase in the ratio of surface area to mass would be expected to adversly affect dissolved oxygen concentration in the Kenai River.

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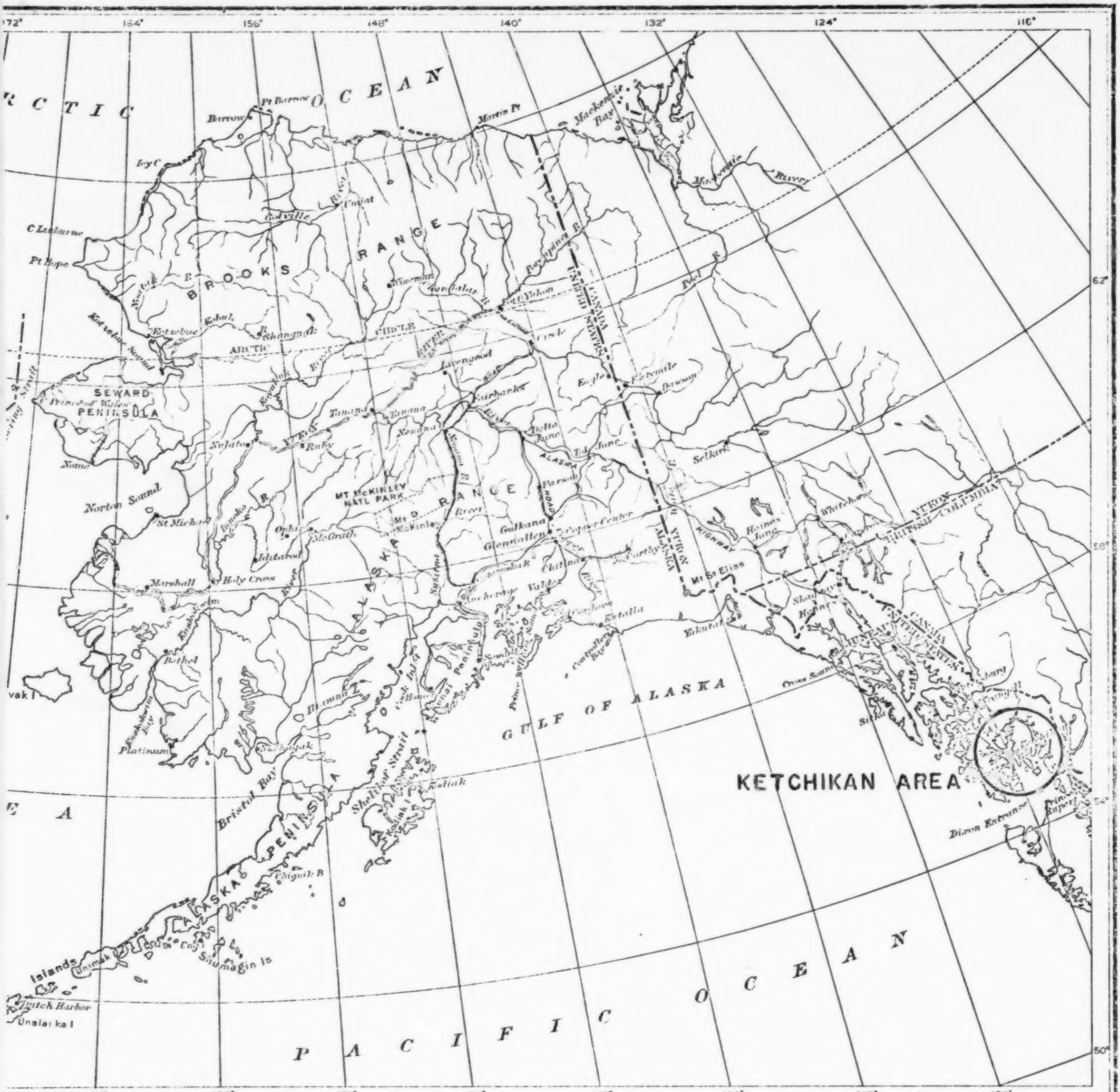
KETCHIKAN AREA

ALASKA



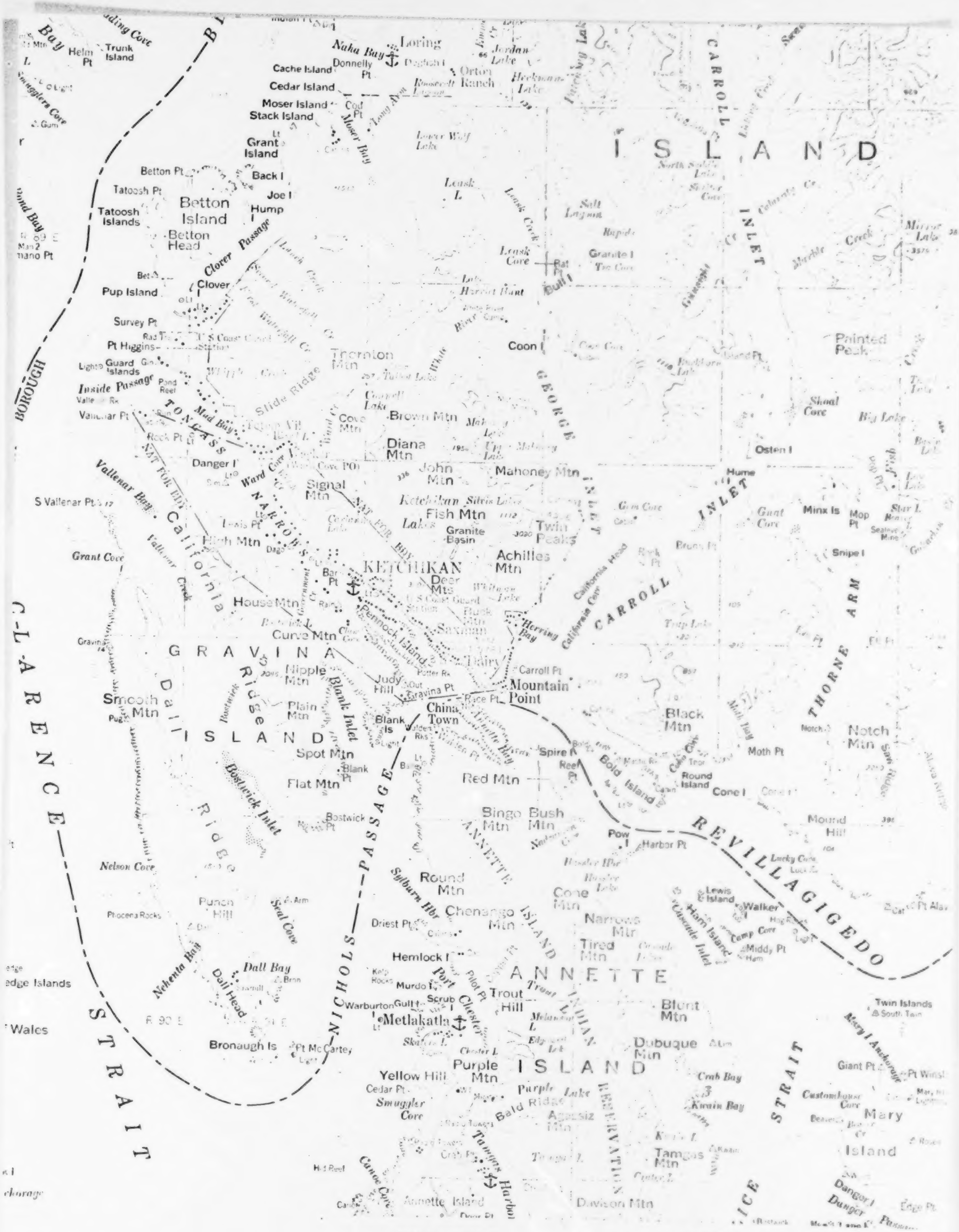
ARCTIC OCEAN
Pt Barrow
Barrow
Icy C
C Lisburne
Pt Hope
Martin Pt
Mackenzie Bay
Mackenzie River
Colville River
BROOKS RANGE
Kotzebue
Kotzebue Sound
Kobuk R
Shungnak
Wiseman
ARCTIC CIRCLE
Fort Yukon
Circle
Porcupine R
UNITED STATES
CANADA
ALASKA
YUKON
Livengood
Fairbanks
Eagle
Fortymile
Dawson
SEWARD PENINSULA
Prince of Wales
Nome
Norton Sound
St Michael
Nulato
Tanana
Ruby
Nenana
Delta Junc
Tok Junc
Selkirk
MT McKINLEY NATL PARK
Mt McKinley
ALASKA RANGE
McGrath
Ophir
Iditarod
Holy Cross
Marshall
Bethel
Gulkana
Glennallen
Copper Center
Chitina
McCarthy
Valdez
Anchorage
Cordova
Katalla
Mt St Elias
Yakutat
Haines Junc
Whitehorse
BRITISH COLUMBIA
Haines
Skagway
Juneau
Cross Sound
Sitka
Wrangell
Cook Inlet
Kenai Peninsula
Prince William Sound
GULF OF ALASKA
Iliamna L
Nushagak
Platinum
Kuskokwim Bay
Bristol Bay
Shelikof Strait
Kodiak
Kodiak I
ALASKA PENINSULA
Chignik B
Shumagin Is
Unimak
Islands
Dutch Harbor
Unalaska I
Nunivak I
KETCHIKAN AREA
Dixon Entrance
Prince Rupert
PACIFIC OCEAN
172°
164°
156°
148°
140°
132°
124°
116°
62°
58°
54°
50°
160°
152°
144°
136°
0 100 200 300 400 500 Miles
100 0 100 200 300 400 500 Kilometers

INTERIOR—GEOLOGICAL SURVEY WASHINGTON D C 1957

ALASKA, MAP C

U. S. GEOLOGICAL SURVEY, FEDERAL CENTER, DENVER, COLORADO OR WASHINGTON 25, D. C

5-2


REVILLAGIGEDO
ISLAND
CLARENCE STRAIT
BOROUGH
GRAVINA ISLAND
ANNETTE ISLAND
KETCHIKAN
TONGASS NARROWS
NICHOLS PASSAGE
CARROLL INLET
GEORGE INLET
THORNE ARM
Loring
Naha Bay
Donnelly Pt
Cache Island
Cedar Island
Moser Island
Stack Island
Grant Island
Moser Bay
Orton Ranch
Jordan Lake
Betton Pt
Tatoosh Pt
Tatoosh Islands
Betton Island
Betton Head
Back I
Joe I
Hump
Clover Passage
Clover
Pup Island
Survey Pt
Pt Higgins
Guard Islands
Inside Passage
Vallenar Pt
Rock Pt
Danger I
Ward Cove
Mud Bay
Vallenar Bay
S Vallenar Pt
Grant Cove
California Ridge
Leask L
Leask Cove
Rat Pt
Bull I
Salt Lagoon
Granite I
Coon I
Painted Peak
Shoal Cove
Big Lake
Osten I
Hume
Minx Is
Mop Pt
Snipe I
Thornton Mtn
Slide Ridge
Connell Lake
Cove Mtn
Brown Mtn
Diana Mtn
John Mtn
Mahoney Mtn
Signal Mtn
Ketchikan Lakes
Fish Mtn
Granite Basin
Twin Peaks
Achilles Mtn
High Mtn
Deer Mtn
Saxman
Herring Bay
California Cove
Carroll Pt
Mountain Point
House Mtn
Curve Mtn
Pennock Island
Dairy
Nipple Mtn
Judy Hill
Gravina Pt
Race Pt
China Town
Smooth Mtn
Plain Mtn
Blank Inlet
Blank Is
Spire I
Reef Pt
Bold Island
Round Island
Cone I
Black Mtn
Moth Pt
Notch Mtn
Spot Mtn
Flat Mtn
Blank Pt
Red Mtn
Bostwick Inlet
Bingo Mtn
Bush Mtn
Pow I
Harbor Pt
Mound Hill
Nelson Cove
Round Mtn
Sylburn Hbr
Cone Mtn
Lewis Island
Walker
Phocena Rocks
Punch Hill
Seal Cove
Driest Pt
Chenango Mtn
Narrows Mtn
Tired Mtn
Ham Island
Middy Pt
Hemlock I
Dall Bay
Dall Head
Nehenta Bay
Edge Islands
Wales
Warburton
Gull I
Metlakatla
Port Chester
Pilot Pt
Trout Hill
Blunt Mtn
Twin Islands
Bronaugh Is
Pt McCartey
Yellow Hill
Cedar Pt
Smuggler Cove
Purple Mtn
Purple Lake
Bald Ridge
Agassiz Mtn
Dubuque Mtn
Crab Bay
Kwain Bay
Giant Pt
Customhouse Cove
Mary Island
Tamgas Harbor
Tamgas Mtn
Canoe Cove
Annette Island
Davison Mtn
INDIAN RESERVATION
Danger I
Edge Pt
Helm Pt
Trunk Island
Smugglers Cove
0
5
10

SCALE 1:250000

KETCHIKAN, ALASKA

IMMEDIATE POLLUTION CONTROL NEEDS

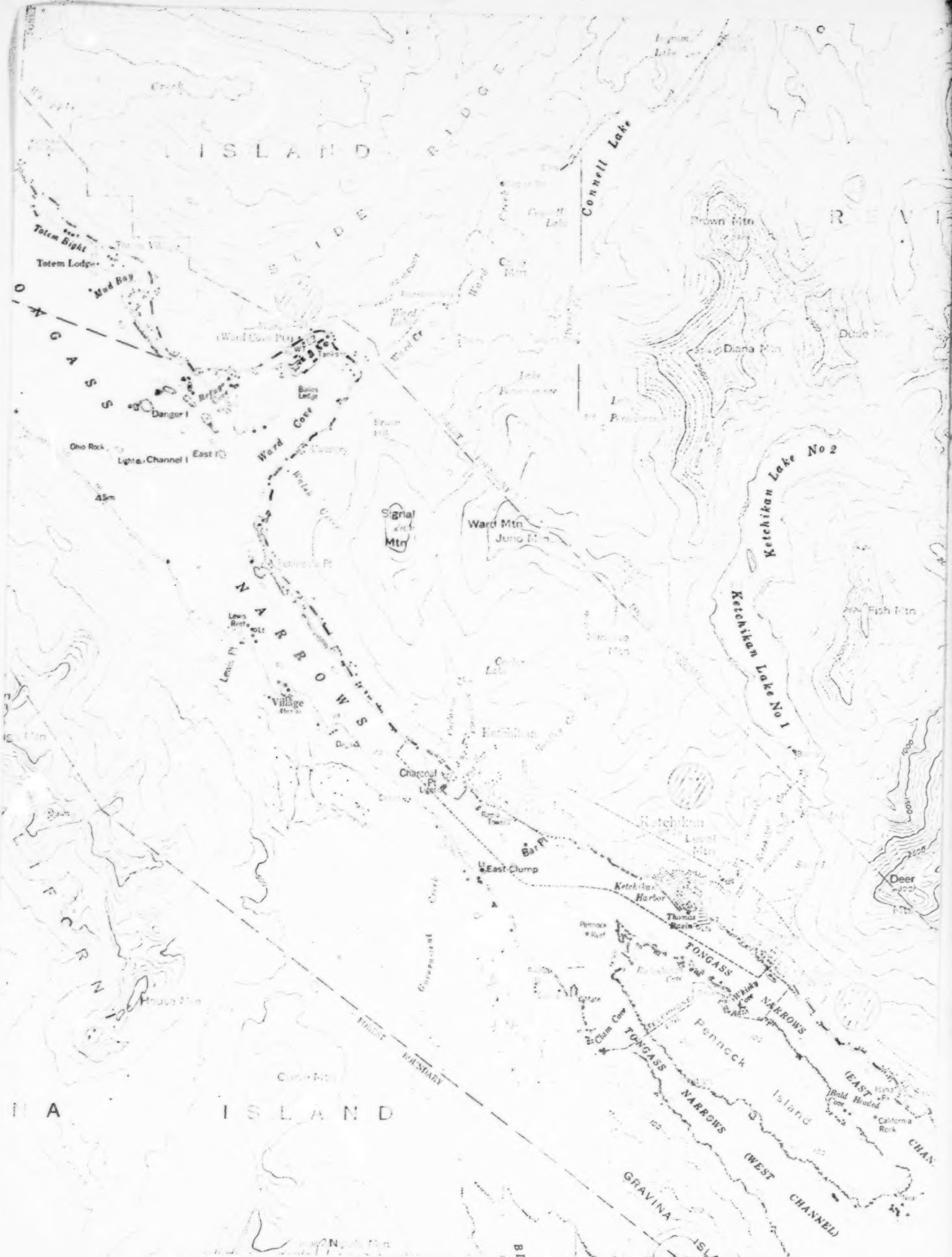
KETCHIKAN AREA

I. INTRODUCTION

This report will serve to delineate and evaluate the sources and extent of pollution in the area within the bounds of the Gateway Borough including the City of Ketchikan. Actions recommended here are proposed to solve existing problems and those presently developing. The waterways included in this area are Tongass Narrows and several small coves and short creeks. Information presented here is based on data obtained from the local government agencies, the State of Alaska Water Pollution Control Activity of the Department of Health and Welfare, and reports of the Federal Water Pollution Control Administration. Water quality information is derived from previous investigations, and no field work was performed for purposes of this report.

Recommendations of this report are based on the best information available with regard to water quality conditions and immediate pollution control needs. Consequently, only those more obvious problems have been presented. Also, owing to the sinuous coast line and the typical archipeligo type of landforms and waterways, the area concerned is relatively small and is considered to have little if any effect on waters in contiguous areas.

Authority for this report is contained in Section (3) of the Federal Water Pollution Control Act as amended, which covers initiating of comprehensive programs for abating pollution in interstate waters. The Presidential Executive Order 11288 covering pollution by governmental operations; and the Alaska Statute, Water Pollution Control Act; and consequent regulations and proposed water quality standards promulgated thereunder were all considered in deliberation on the pollution needs given in this report.


ISLAND
RIDGE
SLIDE
Connell Lake
Brown Mtn
Diana Mtn
Dude Mtn
Ketchikan Lake No 2
Ketchikan Lake No 1
Fish Mtn
Deer Mtn
Totem Bight
Totem Lodge
Totem Village
Mud Bay
TONGASS
Ward Cove PO
Ward Cove
Ward Lake
Ward Cr
Bates Lodge
Refuge Cove
Danger I
Ohio Rock
Light
Channel I
East I
Signal Mtn
Ward Mtn
Juno Mtn
NARROWS
Lewis Reefs
Lewis Pt
Village
Charcoal Pt
Bar Pt
East Clump
Ketchikan
Ketchikan Level Mtn
Ketchikan Harbor
Thomas Basin
Pennock Reef
TONGASS NARROWS
Whisky Cove
Clam Cove
Pennock Island
TONGASS NARROWS (WEST CHANNEL)
(EAST CHAN
Bald Headed Cove
California Rock
House Mtn
FOREST BOUNDARY
ISLAND
GRAVINA ISLAND
1000
1500
2000
2500

II. SUMMARY OF POLLUTION PROBLEMS

Pollution of Tongass Narrows is technical in nature since degradation of the waters is difficult to demonstrate due to significantly voluminous tidal currents, with one exception; that is the industrial waste pollution of Wards Cove by Ketchikan Pulp Company, and it is abundantly obvious. Corrective proposals are tabulated below:

	Responsibility	Need	Relative Priority	Vicinity Map Index
1.	City of Ketchikan	Interceptors and adequate treatment with post chlorination	(A)	1
2.	U.S. Coast Guard	Secondary treatment with post chlorination	(A)	2
3.	Fisheries Products Processors	Solids removal and adequate dilution	(A)	scattered
4.	Ketchikan Pulp Co.	Improved solids handling. Primary treatment of sulfite waste liquor and extend outfall to adequate dilution.	(A)	3
5.	Individual premises outside developed areas	Minimum of primary treatment and chlorination. Outfalls to deep water	(B)	scattered
6.	City of Ketchikan and Gateway Borough	Proper disposal of refuse, garbage and junk	(B)	area wide
7.	Small privately owned sawmills	Removal of solid wastes from waterway	(B)	scattered
8.	Privately owned sand and gravel suppliers	Sedimentation of wash water prior to discharge	(B)	scattered
9.	Local Government and commercial water freight companies	Collection of vessel sewage and wastes and discharge to municipal system	(B)	scattered
10.	Small boat harbors	Institutional needs are a comprehensive area wide sewerage and industrial waste control plan by the joint efforts of the City of Ketchikan and Gateway Borough. Informal visits with officials of these	(C)	area wide

Responsibility	Need	Priority
Small boat harbors (Continued)	agencies indicate such studies are presently being undertaken. Also underway is the State of Alaska's action to bring its water quality standards into harmony with the requirements of the Federal Water Pollution Control Act, Section (10) as amended in 1965.	

III. IMMEDIATE CONTROL NEEDS

Several definite actions are indicated to abate existing pollution of waters tributary to Tongass Narrows and to prevent future degradation of these waters and enhance the many beneficial uses:

1. Waste Treatment

The City of Ketchikan and the Gateway Borough should construct interceptor sewers and one or more treatment plants with appropriate outfall to meet the needs of the above mentioned water quality standards. Design population for this project would be about 12,000 persons. This is a high priority project. Individual premise, commercial, and residential requirements will not be itemized here.

Fish processing plants in the Ketchikan area should provide inplant separation of solids and discharge of remaining liquid wastes to adequate dilution water in Tongass Narrows. Some joint activity with the municipal sewer system may be indicated. Solids should be processed for by-products or disposed of so no nuisance pollution will result.

The U. S. Coast Guard is designing a collection system and secondary treatment for all liquid wastes from its Ketchikan Base as well as those from its assigned and itinerant vessels.

The Ketchikan Pulp Company which operates a magnesium oxide process mill at Ward Cove should: (1) further reduce solid wastes deposited in the waterway, (2) provide a minimum flow in Ward Creek through its catchment dam to protect spawning habitat for historic runs of anadromous fish and to enhance the esthetic values of the U.S. Forest Service Recreational Area which includes the creek bed below the dam, (3) collect liquid wastes and provide adequate sedimentation and sludge disposal to minimize the quantities of fine solids in the mill sewage, and (4) extend the mill outfall to a location which would assure adequate dilution in Tongass Narrows. These last two would entail a major effort and expenditure of funds, and only additional treatment beyond primary would substitute for the need for an outfall extention.

2. Solid Wastes Disposal

The local governments should jointly provide for refuse, garbage, and junk disposal in a manner which will keep all such matter from entering the waterway or being deposited at the high tide line. The sawmills in the area should discontinue depositing solid wastes in the waterway.

3. Vessel Generated Sewage

The steamship companies and local governments should jointly provide facilities to receive wastes from docked vessels and require that self-contained sewage handling equipment be used on all vessels navigating inshore or mooring at local facilities.

Shoreside toilet facilities for permanent and itinerant vessel crews should be provided at all small boat harbors. Any sewage discharge into confined intertidal waters should be discontinued.

4. Institutional Needs

The state and local public health and water pollution control activities must be aided in establishing an effective surveillance and enforcement program if any degree of pollution abatement and prevention is to be attained. The cooperation and influence of the full scope of the Federal Water Pollution Control Administration program is needed in this effort.

5. Research

Needed investigations in handling of fish processing wastes and pulp mill waste disposal are covered in other reports accompanying this submittal.

IV. COSTS

Municipality	Estimated Cost
City of Ketchikan and Gateway Borough interceptors and treatment works harbor collection facilities	$2,100,000
Fisheries Processors	
Collection and disposal facilities	$1,500,000
Pulp Mill Wastes	
Treatment plant mill outfall	$2,250,000
U. S Coast Guard Base	
Collection system treatment works	$ 100,000
Individual Premises	
Individual unit for estimate Number 500	$1,000,000

V. RECENT PROGRESS IN POLLUTION CONTROL

In recent years the City of Ketchikan has extended several outfalls to deeper water and has eliminated others. While this does not result in BOD removal, it does remove floating sewage solids from waterfront beaches and floats.

The Ketchikan Pulp Company has installed new wood room screening devices to remove a greater percentage of bark and other solids from wood room sewers. They have also installed a new chemical recovery boiler to keep up with their increased production. Studies by FWPCA, NW Regional Office, during 1965, established the efficiency of the mill waste product procedures.[1]

Under the program of the federal agencies to abate environmental pollution as instructed in Executive Order 11288, the U. S. Coast Guard has budgeted for and placed in design status a construction project to provide interceptors, vessel wastes collection, and a secondary sewage treatment plant. Their promptness and thoroughness in this program is exemplary.

VI. BACKGROUND

A. Pertinent Basin Characteristics

The landforms of the Ketchikan area were created by pleistocene glaciers resulting in mountains rising steeply from sea level. The waterways are the typical fjords of glacial coastlines. The steep slopes are heavily forested by predominantly spruce and hemlock timber, with the exception of recently "clear-cut" logged areas. Muskeg meadows cover any relatively level ground. The shorelines of the islands are typically bare rock with a few gravel or shingle beaches situated in coves exposed to wave action.

Tongass Narrows, a stretch of the "Inland Passage" to Alaska, is about 16 miles long and lies in a SE-NW direction. Tidal currents vary from .2 to 1.2 knots with mean tide fluctuations of about 13 feet. The water has a salinity of about 30 parts per thousand with relatively fresh surface layers of 6 to 10 feet depending on the recent precipitation.

The climate is cold maritime and boasts the unusally high average annual rainfall of 155 inches. The coniferous rain forest provides only moderate regulation to the runoff of this great precipitation, owing to the steep profile of all the watersheds. The accompanying vicinity maps adequately show the several waterways of the area covered in this report. The major streams in the area are used for power generation, water supply, and have significant recreational use. In addition, the marine waters are used extensively for commercial and sports fishing, transportation, storage of logs, and for commercial transportation.

B. Water Quality Problems

Tongass Narrows, which approximates sea water in salinity, receives all of the raw sewage from the municipal sewers of Ketchikan and from a great many residential areas along beaches outside the city. These waters are considered polluted since present state water quality standards require a minimum of primary treatment with effective disinfection. Updated standards are presently being adopted and may require a higher degree of treatment.

Waste products from seafood processors are discharged direct to the channel beaches. This practice creates a nuisance, and in some cases results in degradation of the waterway. A practical method of dealing with fishery wastes should be developed and implemented.

Two minor pollution problems, which must nonetheless be kept in mind, are accidental oily discharges from bulk petroleum products terminals and deleterious effects of log storage due to blocking of daylight and deposition of loose bark.

The two small boat harbors are polluted by sanitary sewage discharged from vessels; some permanent, others itinerant. These harbors are essentially closed bodies of brackish water with very little circulation.

Ward Cove, a small narrow-necked body of seawater about 4 miles north of Ketchikan and opening into Tongass Narrows, is the site of the Ketchikan Pulp Company mill. This Company uses a magnesium oxide-based pulping process of about 600 tons per day capacity and manufactures dissolving grade pulp for export. Mill effluent consisting of wood fines and spent sulfite liquor (SSL) is carried in 45 million gallons of water a day. Loss of solids from the mill averages 320 tons a day. The mill sewer discharges adjacent to the buildings in a small bight on the north shore of the cove.

A survey of Ward Cove water quality was conducted by FWPCA in late August 1965. Concentrations of sulfite waste liquor in the cove were extremely high and above accepted toxicity levels known to be lethal to small fishes and fish food organisms. Further evidence of pollution is the depressed levels of dissolved oxygen and pH below the minimums set down in the Alaska Water Quality criteria contained in their pollution control regulations.

In order to abate the demonstrated pollution, primary treatment of mill sewer effluent and extension of mill sewer outfall to a location where adequate dilution is available will be necessary.

VII. BIBLIOGRAPHY

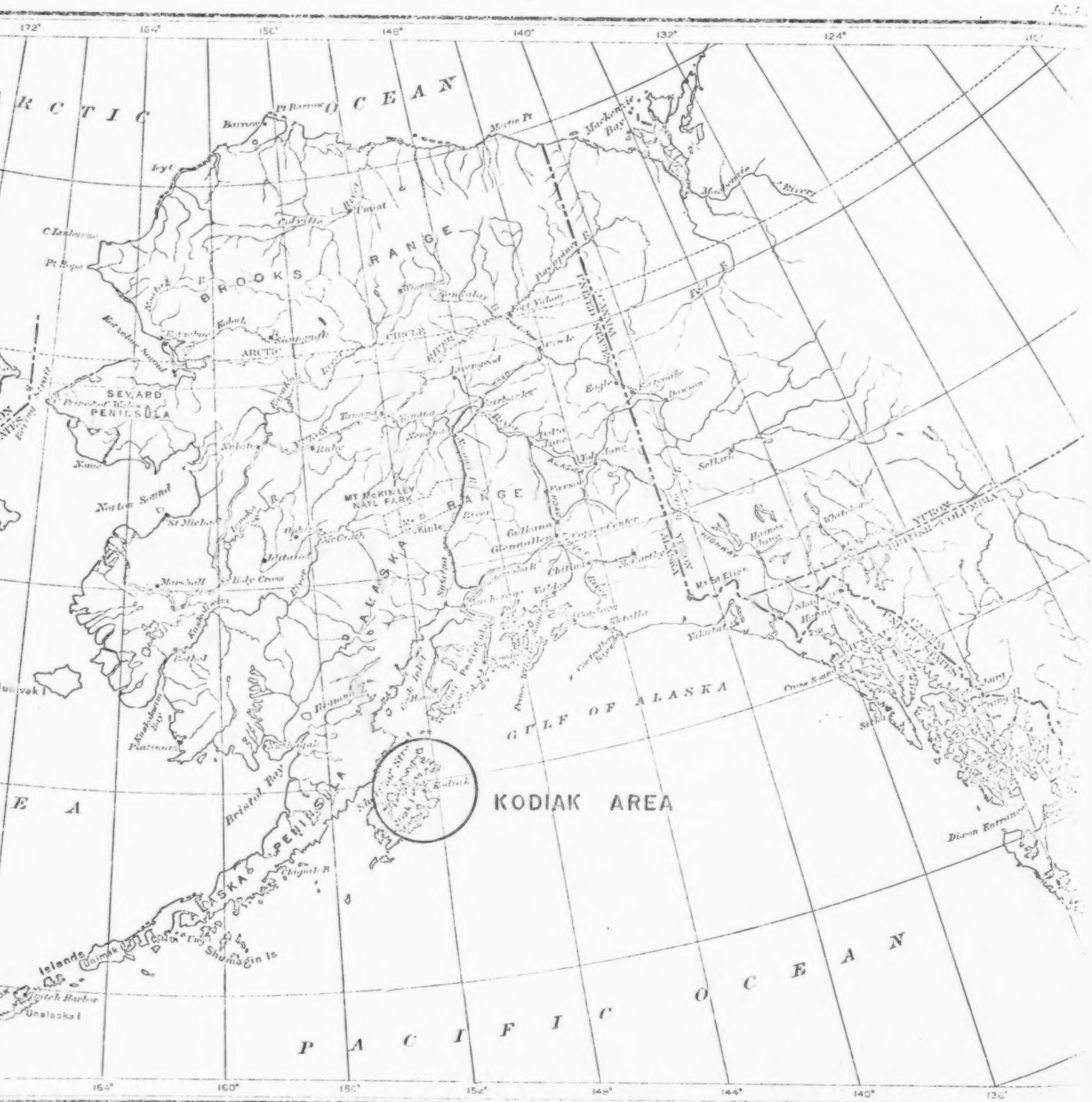
1. Oceanographic and Related Water Quality Studies in Southeastern Alaska, August 1965, FWPCA, NW Region.

2. Ward Cove Survey, Alaska Water Pollution Control Board Report No. 7.

3. Alaska Administrative Code, Title 7, Sub Chapter 4.

4. Various publications of data such as Tide Tables, Climatological Summary, USGS Stream Flow Records, etc.

KODIAK AREA

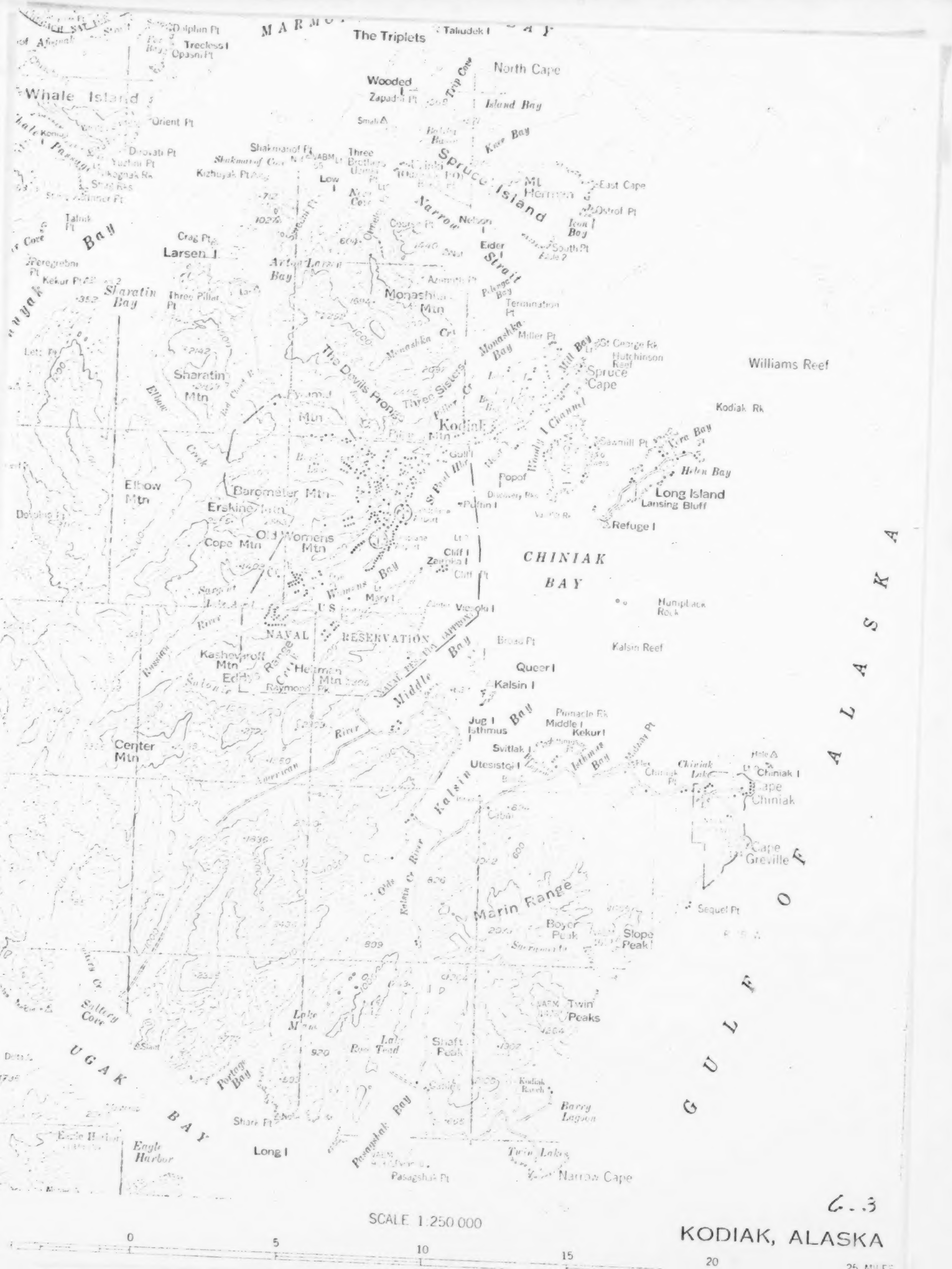

ARCTIC OCEAN
Barrow
Pt Barrow
Icy
C Lisburne
Pt Hope
Colville
Umiat
BROOKS RANGE
Kotzebue Sound
Kobuk
Noatak
ARCTIC CIRCLE
Circle
Fort Yukon
Porcupine R
Mackenzie Bay
Mackenzie River
UNITED STATES
CANADA
Livengood
Fairbanks
Eagle
Dawson
SEWARD PENINSULA
Nome
Norton Sound
St Michael
Nulato
Tanana
Ruby
Yukon
Selkirk
MT McKINLEY NATL PARK
ALASKA RANGE
Gulkana
Glennallen
Copper Center
Chitina
McCarthy
Mt St Elias
Valdez
Anchorage
Kenai Peninsula
Cook Inlet
Prince William Sound
Cordova
Katalla
Yakutat
Cross Sound
Sitka
Haines
Skagway
Juneau
Wrangell
Ketchikan
Dixon Entrance
BRITISH COLUMBIA
Marshall
Holy Cross
Bethel
Nunivak I
Kuskokwim Bay
Platinum
Bristol Bay
Dillingham
ALASKA PENINSULA
Chignik B
Shumagin Is
Unimak
Islands
Dutch Harbor
Unalaska I
Kodiak
KODIAK AREA
GULF OF ALASKA
PACIFIC OCEAN
172°
164°
156°
148°
140°
132°
124°
116°
160°
152°
144°
136°
100 0 100 200 300 400 500 Miles
100 0 100 200 300 400 500 Kilometers

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C. 1957

ALASKA MA

BY U. S. GEOLOGICAL SURVEY, FEDERAL CENTER, DENVER, COLORADO OR WASHINGTON 25, D. C.

6-2


The Triplets
Taludek I
North Cape
Wooded I
Zapadni Pt
Trip Cove
Island Bay
Whale Island
Orient Pt
Dolphin Pt
Treeless I
Opasni Pt
Shakmanof Pt
Shakmanof Cove
Kizhuyak Pt
Three Brothers
Low I
Near Cove
Kupreanof Pt
Kodiak
Spruce Island
Mt Herman
East Cape
Ostrof Pt
Icon Bay
South Pt
Narrow Strait
Nelson I
Eider Pt
Talnik Pt
Bay
Crag Pt
Larsen I
Anton Larsen Bay
Peregrebni Pt
Kekur Pt
Sharatin Bay
Three Pillar Pt
Monashka Mtn
Azumith Pt
Termination Pt
Monashka Cr
Monashka Bay
Miller Pt
Mill Bay
St George Rk
Hutchinson Reef
Spruce Cape
Williams Reef
Sharatin Mtn
The Devils Prongs
Three Sisters
Pillar Cr
Pyramid Mtn
Kodiak Mtn
Woody I
Channel
Kodiak Rk
Sawmill Pt
Elbow Cr
Elbow Mtn
Barometer Mtn
Gull I
Near I
Popof
St Paul Hbr
Puffin I
Long Island
Lansing Bluff
Refuge I
Helen Bay
Erskine Mtn
Dolphin Pt
Cope Mtn
Old Womens Mtn
Cliff I
Zaimka I
Cliff Pt
CHINIAK BAY
Womens Bay
Mary I
Sargent Cr
US NAVAL RESERVATION
Viesoki I
Humpback Rock
Broad Pt
Kalsin Reef
Queer I
Kalsin I
Kashevaroff Mtn
Eddy
Range Cr
Heitman Mtn
Raymond Pk
Middle Bay
Russian River
Saltonie
Jug I
Isthmus
Kalsin Bay
Pinnacle Rk
Middle I
Kekur I
Center Mtn
American River
Svitlak I
Utesistoi I
Isthmus Bay
Chiniak Lake
Chiniak Pt
Chiniak I
Cape Chiniak
Kalsin River
Cabin
Olds River
Cape Greville
Marin Range
Boyer Peak
Slope Peak
Sequel Pt
Saltery Cove
Lake Miam
Twin Peaks
Lake Rose Tead
Shaft Peak
UGAK BAY
Portage Bay
Kodiak Ranch
Barry Lagoon
Pasagshak Bay
Shark Pt
Long I
Twin Lakes
Narrow Cape
Pasagshak Pt
Eagle Harbor
GULF OF ALASKA
SCALE 1:250 000
0
5
10
15
20
25 MILES

KODIAK, ALASKA

6.3

KODIAK AREA

I. INTRODUCTION

The purpose of this summary is to examine and evaluate the sources and extent of pollution in the Kodiak Area and to recommend actions designed to satisfy immediate needs.

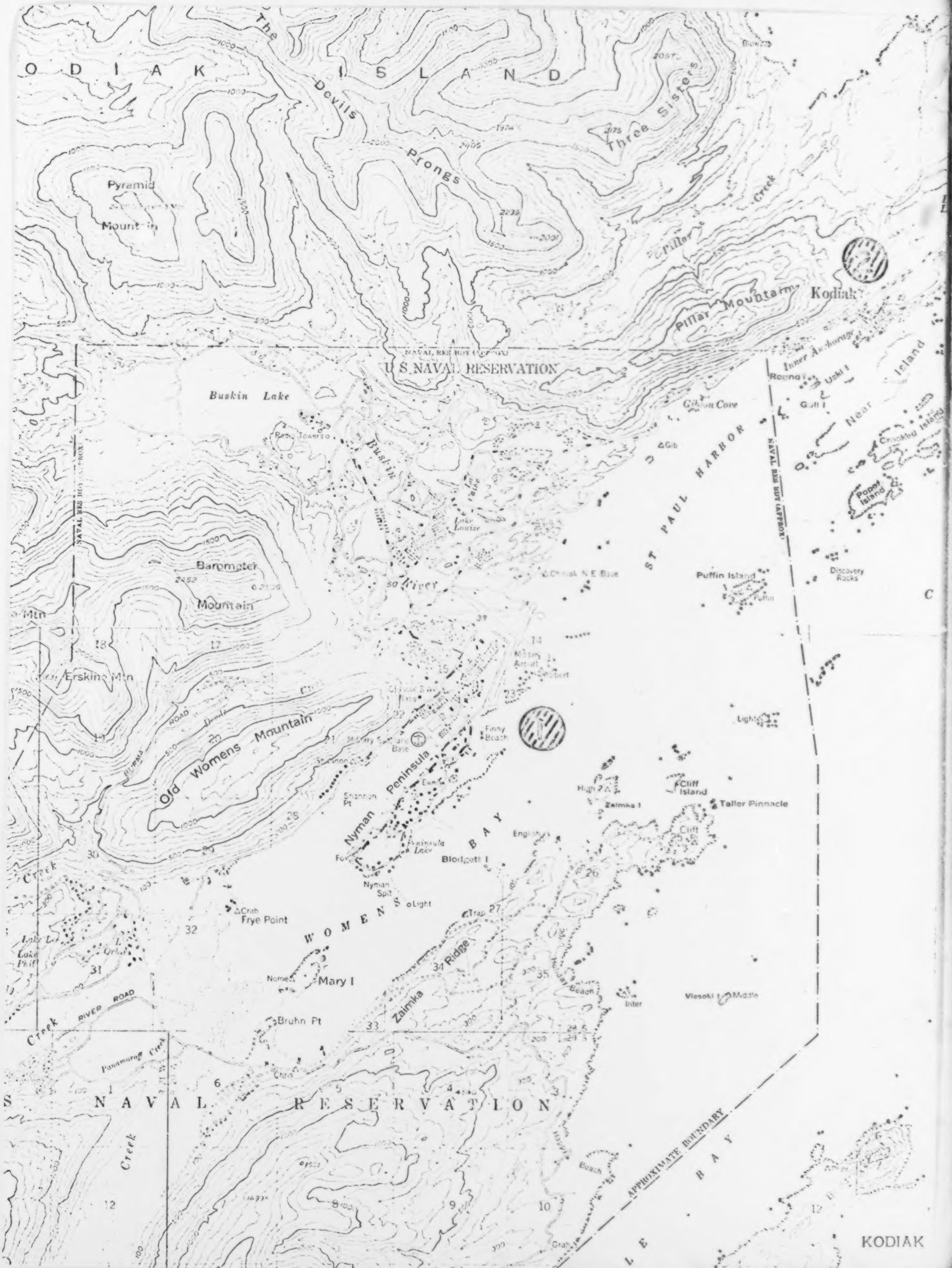
Except for occasional small septic tanks there are no sewage treatment plants in either the City of Kodiak or the nearby U. S. Naval Station. All sewage and septic tank effluent and seafood processing wastes are discharged untreated into Kodiak Harbor, and Womens Bay.

These practices are inconsistant with the Alaska Water Pollution Control Act and the State Administrative Code. The State Department of Health requires that a minimum of primary treatment be given to sewage discharged to surface waters.

In addition to State requirements, Presidential Executive Order 11288 requires Federal installations to provide secondary treatment for all wastes.

The recommendations presented herein, differ from recommendations contained in a report entitled "Feasibility Study for Treatment of Sewage at U. S. Naval Station, Kodiak, Alaska" by Livingstone, Moore and Wallace, Inc., Consulting Engineers. Since their recommendation for only primary treatment is not consistant with Presidential Order 11288, a request for waiver of this requirement has been made by the Navy.

No detailed studies were made in the preparation of this summary, as implementation of these recommendations will require a more detailed engineering design analysis.


ODIAK ISLAND
The Devils Prongs
Three Sisters
Pyramid Mountain
Pillar Creek
Pillar Mountain
Kodiak
U.S. NAVAL RESERVATION
NAVAL RES BDY (APPROX)
Buskin Lake
Buskin River
Lake Louise
Barometer Mountain
Erskine Mtn
Old Womens Mountain
Nyman Peninsula
Peninsula Lake
Nyman Spit
Shannon Pt
Military Seaplane Base
Finny Beach
Gibson Cove
Gib
ST PAUL HARBOR
NAVAL RES BDY (APPROX)
Inner Anchorage
Round I
Uski I
Gull I
Near Island
Crooked Island
Popof Island
Puffin Island
Puffin
Discovery Rocks
Light
Cliff Island
Taller Pinnacle
High
Zaimka I
Blodgett I
WOMENS BAY
Light
Frye Point
Crab
Mary I
Nome
Zaimka Ridge
Holiday Beach
Bruhn Pt
Vlesoki I
Middle
Inter
Panamaroff Creek
Creek
RIVER ROAD
NAVAL RESERVATION
APPROXIMATE BOUNDARY
BAY
Beach
1000
1500
2000
2405
2239
2091
2452
2126
500
100
300

KODIAK

II. SUMMARY OF MAJOR POLLUTION PROBLEMS, COSTS OF ABATEMENT, AND RESPONSIBLE AGENCIES.

Responsible Agency & Nature of Waste	Immediate Treatment Needs	Estimated Cost to Correct	Relative Priority	Vicinity Map Index
Kodiak Naval Station (Domestic sewage)	Secondary treatment and disinfection	2,500,000	(A)	1
Kodiak Naval Communication Station (Domestic sewage)	Secondary treatment and disinfection	250,000	(A)	1
City of Kodiak and Suburban areas (Domestic sewage)	Secondary treatment and disinfection	1,500,000	(A)	2
18 privately owned seafood processing plants (seafood wastes)	Separation of solids at cannery and disposal of liquids to adequate dilution water. Solids to be disposed of by owner of cannery in accordance with local solid waste disposal practices. (Also please refer to section of this report pertaining to fish industry)	100,000	(B)	2
Boat Harbor (Domestic Wastes)	Primary treatment and disinfection (connect to municipal system)	50,000	(B)	2

III. IMMEDIATE CONTROL NEEDS

The Kodiak area economy is based essentially on fishing and fish product manufacturing, with some income derived from agriculture, tourism and military payrolls. The Kodiak area produces about 30% of Alaska's canned crab production and about 50% of the frozen crab production. The importance of this industry is apparent when one considers that approximately 90% of the Pacific Coast crab production comes from Alaska.

KODIAK AREA

At the present time, all of Kodiak's sewers and waste fishery products are discharged directly into tidewater along the cities waterfront.

The continued discharge of untreated pollutants into the waters of Kodiak Harbor has led to a depletion in water quality. This discharge also leads to deterioration of the waters and shore areas surrounding the City of Kodiak and the Naval Station, creating potential health hazards and leading to aesthetic and nuisance problems.

Residential areas outside the municipal water and sewer system use shallow wells (actually sumps), and septic tanks. Groundwater pollution from septic tank drainfields has been detected in most of the domestic water wells tested.

In order to abate the existing pollution problem in the Kodiak area, the following immediate steps are recommended, in order of priority.

A. Construct interceptor sewers and treatment plants to treat all domestic wastes originating at U.S. Naval facilities at Kodiak.

B. Extend the existing sewer system in the City of Kodiak to areas not now served by sewers. Construct a primary treatment plant and intercept existing outfalls.

C. Dispose of liquid fish processing waste to adequate dilution water. Separate solids at cannery and dispose of them by suitable solid waste disposal practices.

IV. RECENT PROGRESS IN POLLUTION CONTROL

The disposal of seafood processing solid wastes presents a fairly sizable problem at Kodiak. The City of Kodiak is presently attempting to reach a solution, by requesting seafood processors to participate in the funding of a marine protein concentrate pilot plant.

The Governor of Alaska has endorsed the establishment of a Fisheries Research Center for the state. There are indications that the institution might be located in Kodiak. The National Council on Marine Resources and Engineering Developments is also expected to provide some insight into the possible uses of seafood wastes, and provide leadership in the development of useful products. By discovering a by-product use for seafood wastes the existing problems of waste disposal will be greatly simplified.

The Navy Department engaged the consulting firm of Livingstone, Moore, and Wallace, Inc. to make a feasibility study of the sewage disposal system at the U.S. Naval Station and Communication Station at Kodiak. This report was completed in 1965, and the Navy has submitted programming documents (DD form 1391) for the correction of deficiencies noted in this report.

An urban renewal project (R-19, Stage II) is presently under construction and includes modifications to the Kodiak City Sewer System; however, no treatment plant is envisioned.

V. BACKGROUND FOR RECOMMENDATIONS

A. Pertinent Characteristics

1. Geography

KODIAK AREA

Kodiak Island, the largest island among the Kodiak group, is located about 35 miles east of the Alaskan Peninsula and 250 miles southwest of Anchorage.

The Kodiak Area, discussed on this summary, is situated on the northeastern corner of Kodiak Island. This area is delineated by the corporate limits of the City of Kodiak, and the principal population center of the U.S. Naval Station. The total geographic area to be considered comprises approximately 2,000 acres.

2. Topography and Geology

Kodiak Island is a rugged mountainous region with peak elevations exceeding 4,000 feet. The shoreline is indented with numerous bay and long narrow fjords. The intricate shorelines were eroded by Ice Age Glaciation.

The geology of the island is a southern extension of formations on the Kenai Peninsula and exhibits rocks of Mesozoic and earlier ages.

The City of Kodiak is nestled at the foot of 1,500 foot Pillar Mountain, on a bench which more or less parallels St. Paul Harbor. Elevations range from 20 feet near the coast line to several hundred feet southwest, where the bench narrows, and northeast, where the bench blends into rolling hills dotted with small lakes and swamps. Slopes ranging between 7 and 80% grade, are a factor which has definitely restricted development in the Kodiak metropolitan area. The trend of growth is east, where slopes are more gentle.

The U.S. Naval Station is located approximately 7 miles southwest of Kodiak on gently rolling terrain between the outlet of Buskin River and Womens Bay. Topographic features are similar to Kodiak.

3. Climate

The City of Kodiak has a maritime climate, tempered by the Japanese Current which sweeps northeastward along the coast of the Alaska Peninsula. Kodiak exhibits fairly stable daily temperatures and maximums seldom reach 70 degrees. The highest temperature ever recorded was 86° in June 1963, while the lowest was -9°F in January, 1917.

The mean temperature is a mild 40.6°F. The average length of the frost-free season is 171 days and generally extends from about the first of May to the middle of October.

Precipitation is abundant all year, and no month averages less that 3 1/2 inches of rain. The least rain occurs in March, July and August. October is the wettest month and receives an average of more than 7 inches. During the winter remaining snow on the ground seldom exceeds 10 inches.

Strong winds are common in the winter and maximum velocities of 92 knots have been recorded.

4. Population

In 1960 the population of the City of Kodiak was 3,000. Following the 1964 earthquake and subsequent implementation of the urban renewal project plus rapid expansion of the King Crab industry the population swelled to the present estimate of 7,500. Two thousand persons are estimated to reside in areas outside of the city confines.

5. Industry

The basic industry of Kodiak is seafood processing. Tourism and guide service for hunting the famous Kodiak Bear are of importance. Kodiak also serves as the trade and service center for a large part of the Aleutian Islands.

For 20 years prior to 1951 the economy of the community depended about half and half on the Naval Station and the fishing industry. However, since 1951 the local fishing industry has been expanded to include King Crab and shrimp. During 1966 over 90 million pounds of King Crab were caught and processed in the Kodiak area.

The demand for fish products especially King Crab, shrimp, and halibut has changed Kodiak from a relatively small sporadic and seasonal salmon canning economy into one with large investments and year-round payrolls.

Fourteen fish product companies line the waterfront where just four years ago only three operated.

Before 1966, boat landings of King Crab exceeded the capacity of available processors and thus delayed boats from unloading. In addition, crab canneries ran short of fresh water and unvoluntarily ceased operation several times during the summer. Consequently, fishermen were forced to hold crabs until the processor was in a position to receive them. Long delays occurred, crabs were lost owing to suffocation in live tanks, and fishermen lost both time and revenue.

Part of the mortality was attributed to inadequate circulating pumps and tanks loaded beyond crab tolerance for confinement. Another factor was the circulation of sea water which had been organically polluted from crab wastes discharged from the canneries during processing. Oxygen depletion of receiving waters, largely from the discharge of crab wastes, suffocated live crabs before they could be processed. The Alaska Department of Fish and Game monitored dissolved oxygen in waters at and adjacent to the canneries. During the period 3/24/66 through 1/30/67 they recorded oxygen levels showing a high degree of depression from normal expected ranges. For instance, on August 23, 1966, only 2.3 ppm oxygen was noted in the small boat harbor.

6. Streams and Rivers

Only one watercourse of consequence is located within the Kodiak Area. Buskin River flows about 6 miles from Buskin Lake to tidewater. The system is entirely within the U.S. Naval Reservation. The lake serves the Navy base as a source of primary water supply.

The river and lake supports a large run of pink, coho and chum salmon. Dolly Varden char are present also. The Buskin River system, owing to its accessibility and good fish populations, receives heavy use from anglers, especially military personnel.

7. Vegetation

Kodiaks' rather mild maritime climate and heavy rainfall account for the lush vegetation found on bottom lands and hillsides.

Only the highest mountain slopes are barren. The hillsides support stands of Sitka spruce, grasses, forbes and shrubs. In the bottom land, tall grasses and sedges are intersperced with cottonwood and willow.

B. Present Water Quality Problems

At the present time, the City of Kodiak has an estimated population of 7500 persons, with an additional suburban population of 2000. Most of the domestic sewage is discharged untreated into Kodiak Harbor through five outfalls. One hundred-forty permanent and one hundred-fifty transient persons reside on boats in the boat harbor. All sewage from vessels is discharged into the harbor without treatment.

During 1965, approximately 50 million pounds of fish wastes were discharged into Kodiak Harbor. The largest single contribution is the King Crab industry, which operates on a year-round basis.

By local ordinance, fish waste is ground up before discharge. This method abates the odor problem somewhat, but increases the area to volume ratio and consequently accelerates biochemical degradation. The large swarms of seagulls feeding on cannery wastes create a nuisance problem.

The effect of this unregulated discharge on the quality of the waters in Kodiak Harbor is obvious. Floating solids impair the appearance of the shoreline and malodorous refuse offends the nose. There has been a significant reduction in dissolved oxygen in the waters fronting Kodiak.

KODIAK AREA

The small boat harbor depends upon tidal action for flushing waste materials into the receiving waters of Kodiak Harbor. Tidal currents average .6 knots and do not afford efficient circulation or adequate dilution.

The Naval Station and Naval Communication Station discharge domestic sewage directly or indirectly into Womens Bay and St. Paul Harbor. A small amount of this sewage passes through septic tanks. Numerous outfalls dot the shoreline and these areas are accessible to children playing in the area, thereby presenting an immediate health hazard.

Aside from the obvious effects on the community from floating solids and odor nuisances, and the potential threat to health, the effects of this unregulated discharge on the economy and growth potential of the seafood industry should also be considered.

Although the area has produced significant amounts of salmon, halibut, crab, shrimp and others, major seafood production of industrial importance has only commenced during recent years. Marine biologists agree that the waters are virtually untapped when considering the estimate that one to three billion pounds of seafood could be produced annually from the North Pacific without fear of depletion.

Potential expansion of the seafood industry from these large fishing stocks can multiply the pollution problem unless immediate steps are taken to solve the waste disposal problem!

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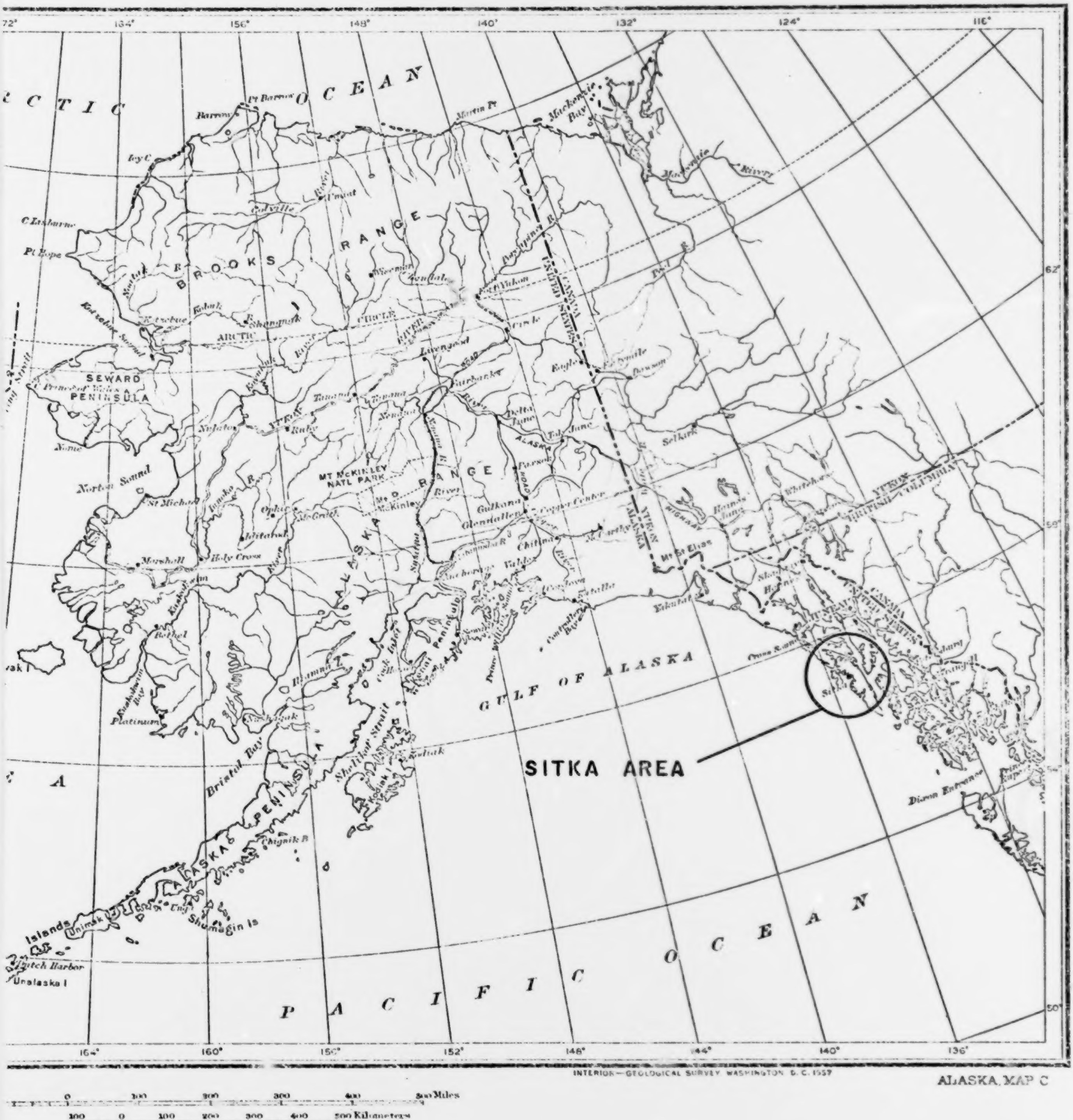
SITKA BOROUGH AREA


ARCTIC OCEAN
BROOKS RANGE
SEWARD PENINSULA
ARCTIC CIRCLE
Norton Sound
MT MCKINLEY NATL PARK
ALASKA RANGE
GULF OF ALASKA
ALASKA PENINSULA
Bristol Bay
Shelikof Strait
Kodiak I
Shumagin Is
Unimak
Dutch Harbor
Unalaska I
Barrow
Pt Barrow
Nome
Fairbanks
Circle
Eagle
Dawson
Valdez
Cordova
Yakutat
Juneau
Sitka
Wrangell
Skagway
Whitehorse
Dixon Entrance
Prince Rupert
UNITED STATES
CANADA
YUKON
ALASKA
BRITISH COLUMBIA
SITKA AREA
PACIFIC OCEAN
172°
164°
156°
148°
140°
132°
124°
116°
160°
152°
144°
136°
62°
58°
54°
50°
0
100
200
300
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100
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500 Kilometers

INTERIOR—GEOLOGICAL SURVEY WASHINGTON D.C. 1957

ALASKA, MAP C

U. S. GEOLOGICAL SURVEY, FEDERAL CENTER, DENVER, COLORADO OR WASHINGTON 25, D. C

7. 2

SITKA BOROUGH AREA

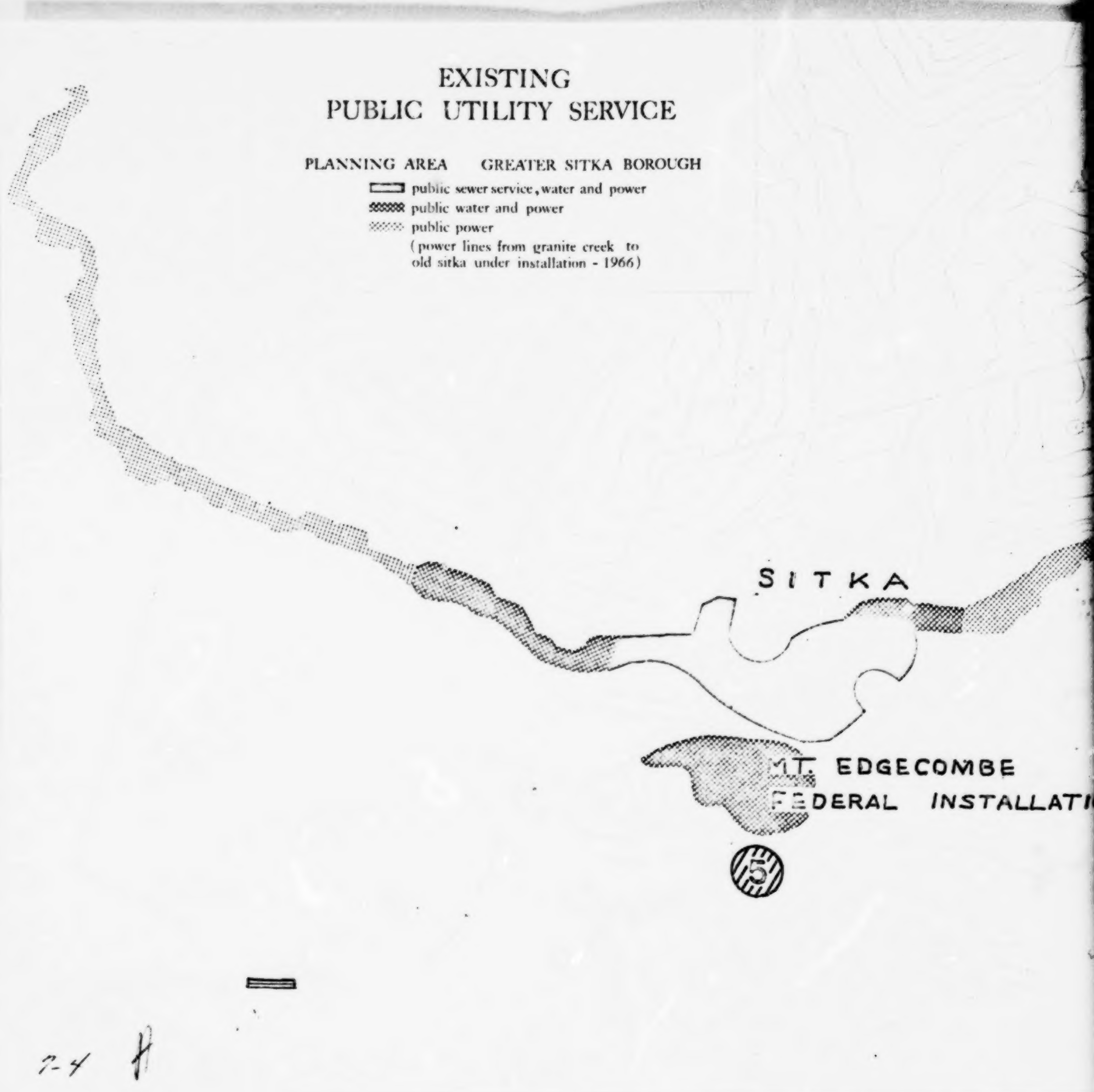
I. INTRODUCTION

The purpose of this summary is to list and evaluate sources and extent of pollution in the metropolitan area of Sitka, Alaska, and to recommend actions to solve immediate problems.

Present polluted conditions are in violation of the Alaska Water Pollution Control Act and the Administrative Code. The Alaska State Department of Health and Welfare requires that at least primary treatment be given to sewage from the City of Sitka and Federal Installations at Mt. Edgecombe.

Authority for this report is the Federal Water Pollution Control Act as amended (33 USC 466). In addition to the State water quality requirements, Presidential Executive Order 11288 requires Federal Installations to provide secondary treatment for all liquid wastes.

Inasmuch as recommendations presented in the references comply with these requirements, implementation of these recommendations is justified. The Alaska Water Laboratory, however, feels that additional study of present water quality is required to assess the importance of chemical pollution by industry in the Sitka area.



EXISTING
PUBLIC UTILITY SERVICE

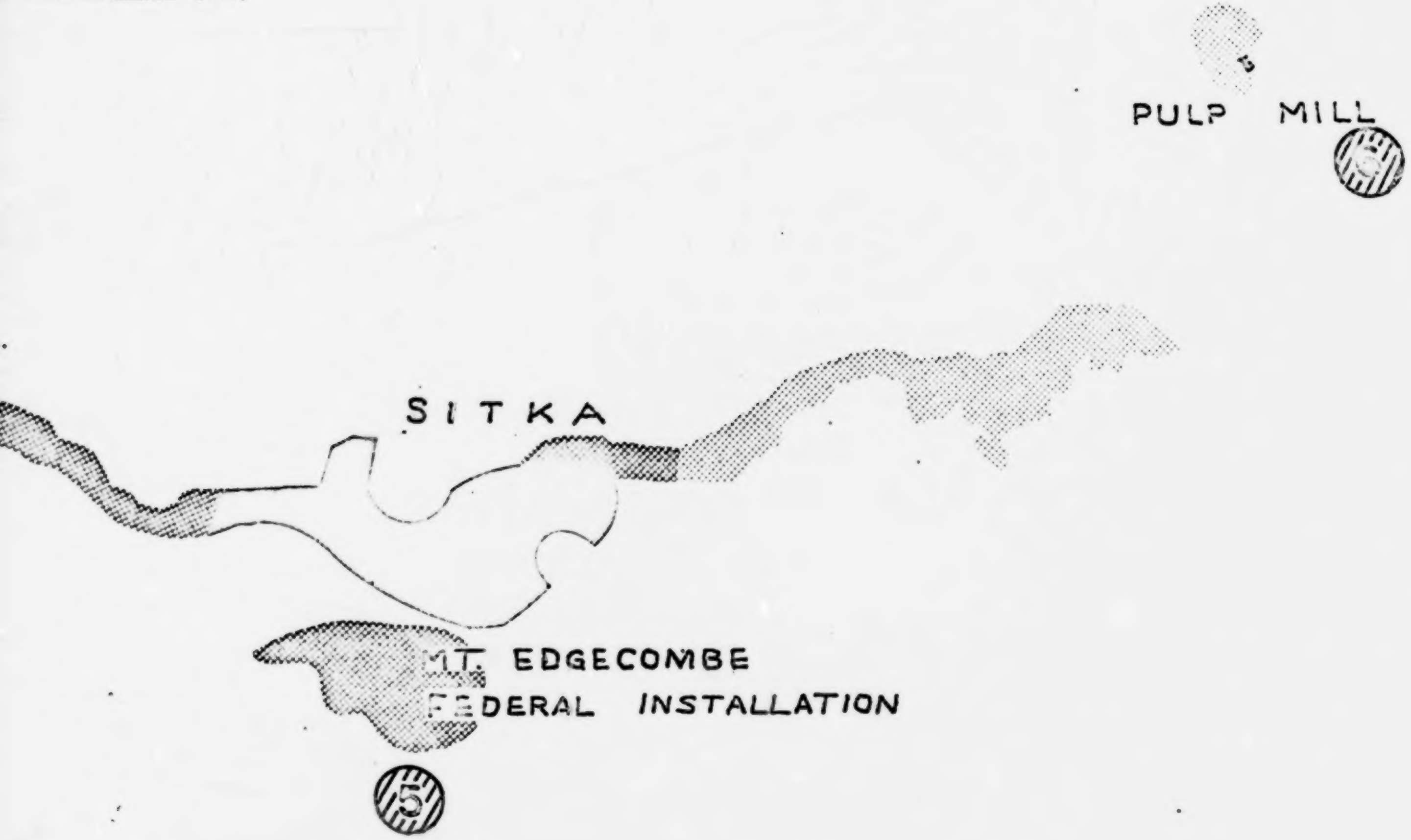
PLANNING AREA GREATER SITKA BOROUGH
▭ public sewer service, water and power
▩ public water and power
░ public power
(power lines from granite creek to old sitka under installation - 1966)
SITKA
MT. EDGECOMBE
FEDERAL INSTALLATI
5

7-4 A

XISTING
TILITY SERVICE

GREATER SITKA BOROUGH

sewer service, water and power
water and power
power
lines from granite creek to
ka under installation - 1966)



5
PULP MILL
6
SITKA
MT. EDGECOMBE
FEDERAL INSTALLATION
5

II. SUMMARY OF POLLUTION PROBLEMS AND RESPONSIBLE AGENCIES

Party or Agency	Remedy	Cost Millions of Dollars	Relative Priority	Vicinity Map Index
Greater Sitka Borough or City of Sitka	Sewers and primary treatment	2.0	(A)	4
Federal Installations on Japonski Island (Mt. Edgecombe)	Sewers and primary treatment	0.5	(A)	5
Fish processors	Separation of solids, disposal of water into sewers.	*	(B)	scattered
Garages, service stations, boats and airplanes	Grease traps and disposal of oil outside sewers.	*	(B)	scattered
Pulp Mill	Removal of additional wood fiber and dissolved solids from red liquor. Reduction of foaming detergent use and installation of primary outfall facility.	1.6	(B)	6
Sitka Borough	Providing for disposal of solid waste, car bodies, rubbish tin cans and garbage in a way that does not damage the environment and water quality.	0.2	(B)	area wide

* Not estimated

III. IMMEDIATE CONTROL NEEDS

The most critical need in Sitka, including the Federal Installations at Mt. Edgecombe, is to provide a primary treatment facility for domestic sewage. The accompanying map shows that only a small area of the borough of Sitka has public sewer service. This area contains approximately 75% of the contiguous population.

Facilities have been planned (1) that would provide a jointly operated facility for the City of Sitka and Mt. Edgecombe. An increase in size of this design would provide for interception of sewage from all of the presently populated areas along the beaches. This would remove the health hazard and unsightliness of outfalls presently along the beaches, many of which are above the water line.

Alleged chemical pollution of the waters of Silver Bay near Sitka by a pulp mill requires further study. Such a study should determine the long range effects of continued pollution at the present level and make recommendations for further treatment if required. As a minimum, additional screening to recover wood solids and additional dissolved solids recovery should be accomplished. In addition, control of effluent concentration by provision of a holding lagoon should be provided. Such a lagoon would assure that accidental loss of chemicals within the pulping operation does not cause the effluent to reach concentrations beyond that recommended by the Alaska Water Pollution Board (2) as a result of their survey prior to plant construction. Recommendations of AWPCB regarding outfall design and location should also be complied with as soon as possible.

IV. COSTS

The cost of providing a sewage system including additional lines, pumping stations, and a primary treatment plant would be $2.5 million. This estimate is based on an existing plan (1) which embraces all of the Japonski Island[1] installations and the present central city in one system. Cost of such a system was estimated by the same report to be

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[1] Japonski Island is the locale of many Federal Installations including FAA, Coast Guard, Bureau of Indian Affairs and the Mt. Edgecombe USPHS Hospital. The complex is sometimes called "Mt. Edgecombe".

$0.87 million. Extrapolation of this design to include a larger area brings the total to $2.5 million. It should be pointed out that 75% of the population of Sitka, including the Federal Installation, would be served by the $0.87 million system. The remaining population, which is strung out along the two roads, would be served at an additional cost of over $1.5 million.

Cost of Sewage Pollution Abatement

City of Sitka and Japonski Island	$0.87 million
(Japonski Island alone	0.5 million)
Remaining contiguous Borough (excepting city)	1.5 million
Integrated System Total	$2.5 million

The cost of additional treatment of wastewaters discharged by the pulp mill is believed to be near $1.6 millions. Of this amount, approximately $0.75 million is required to increase the capacity to recover dissolved solids. Additional treatment of the effluents discharged into the receiving waters would be primarily to recover added chemicals and wood fiber. The resultant saving is not included in the cost estimates.

Additional screening and centrifuging waste waters to increase recovery would cost an estimated $0.38 million. An additional outfall facility, designed to comply with earlier recommendations by the Alaska Water Pollution Control Board (2), is estimated to cost approximately $500,000.

Therefore, total cost of immediate needs is approximately $1.6 million. This would essentially bring waste control and treatment into compliance with existing recommendations of the Alaska Water Pollution Control Board.

V. RECENT PROGRESS IN POLLUTION CONTROL

The pulp mill operated by Alaska Lumber and Pulp Company has continued a program of water quality study in Silver Bay and is proceeding with plans for new controls on waste recovery processes. Their attention is directed toward increasing recovery of processing chemicals and wood fibers, which would result in lower operating costs. They have already achieved significant improvement in waste recovery from the barker and wood room operations and are planning the addition of more screens to recover pulp from wash waters in parts of the pulping process. However, they do not have any plans for additional attention to the dispersion of effluents in the receiving waters nor for a storage lagoon.

The City of Sitka has recently extended several outfalls into the channel below low water. This, in addition to the building of new sewers (presently under construction) within the city, has materially improved sewage disposal within the city. An immediate result of the construction of new lines has been the removal of three of the four sewers that formerly discharged into a recreational lake within town. This lake can be used for boating and fishing when the remaining sewer has been extended past the lake.

VI. BACKGROUND FOR RECOMMENDATIONS

A. The Borough

Sitka and its environs contain much of the historical interest of southeastern Alaska (3). The city is prized as an attractive place in which to live, with a flourishing educational system, cultural attractions, beautiful scenery, and numerous parks and waterfront recreation areas nearby. The surrounding area within a few miles consists of a region of beaches and forest under the management of Tongass National Forest.

Principal sources of income are the fishing industry, pulp mill, institutional and military establishment, and tourist industry. A major tourist attraction is fishing for salmon in local waters, digging of shellfish, and picnicking on the beaches.

B. Population

Population in 1965 is given at 4950 including medium and low density areas connected by road to Sitka proper. Annual growth rate for the next decade is projected to be between 3.5 percent and 4.0 percent. There are an additional 1500 persons on Japonski Island which consists entirely of Federal Installations, principally Mt. Edgecombe, the U.S. Public Health Service Hospital.

C. Environment

The climate of Sitka is sub-polar maritime, with narrow temperature ranges, generally between 32° and 55° F. Precipitation occurs on 200 days of the year, mostly as light rain.

Geologically, Sitka is on a low shelf between a submerged glaciated valley and precipitous glaciated peaks. Permeable soil covering the rocky basement is shallow and contributes to difficulties in sewer system construction and operation, as well as to problems in building and road construction.

Vegetation is dense and luxuriant. Predominant species are conifers which provide a mainstay of the area's industry. Undergrowth consists of thick layers of sphagnum moss and low shrubs from which is derived the muskeg nature of the soil.

Nearby waters are oceanic and have a salinity between 30 and 33 parts per thousand at depth; however, salinity of surface water may decrease to as low as 10 parts during seasons of high runoff. Currents in the boat harbors and along nearby beaches are of considerable strength owing to the 7 foot tidal ranges, and are to be considered in sewage-outfall design. Local winds vary from generally offshore in winter to onshore during spring and summer. As a result, periods exist when surface currents tend to cause accumulations from sewage outfalls wherever such outfalls lie to the southwest and are close to shore.

VII. PRESENT WATER QUALITY PROBLEMS

Present pollution problems are demonstrated by the appearance of floating sewage in the boat harbor, numerous sewer outfalls along the beaches, and the appearance of raw sewage above ground levels in some areas of town. Some of the many sewer outfalls in nearby waters are such that onshore currents deposit sewage solids on beaches.

A bond issue was recently rejected that would have provided for sewers in a part of town which is plagued by inadequate drainage for septic tank systems. At present there is no plan to provide primary treatment facilities for the municipal sewer system. Lack of adequate sewers and no treatment plant cause pollution of nearby beaches. These beaches could provide recreation for the local population and be used by summer visitors from other states as well were it not for the presence of obnoxious debris and water.

Pollution of nearby waters by the pulp mill requires that additional study be carried out and that recommendations made by Alaska Water Pollution Control Board be implemented. Allegations are that the biological community of the marine environment has been altered by chemical pollution due to sulfite waste liquor. It is apparent that the use of hard detergents in one of the mill processes causes a persistent foam to appear on the water and beaches at times, depending on weather conditions.

A recent (1965) report by the FWPCA (4) shows that chemical alteration of the water has occurred. This report also shows that under certain climatic conditions, such as with westerly winds which occur during summer months, waste liquor concentrations may achieve levels that are toxic to many species in the marine food chain. Concentrations of waste sulfite liquor may also be high because of unusual operating conditions in the mill or maintenance problems with recovery equipment. Long periods of time are required by the biological community to recover from short periods of exposure to lethal levels of toxic wastes in the waters.

Recent data collected by Alaska Water Laboratory presents evidence of changes in the biota of beaches near the pulp mill (5). Local residents frequently mention other biological changes, allegedly caused by pollution. Foremost among these are complete disappearance of spawning herring runs in Silver Bay and reduction in numbers of certain molluscs. A decrease in the growth rate of edible clams is also indicated.

Recommendations by the Alaska Water Pollution Control Board (2), subsequent to a site survey in 1957 before the pulp mill went into operation, were not followed with regard to outfall location and design, nor was a storage lagoon provided. Evidence suggests that, had treatment facilities and waste disposal recommendations been followed, pollution would now be under better control.

Organic Sedimentation

Road building and land clearing around Sitka has resulted in deposition of muskeg silt in the bottom of some waterways. This results in a biological oxygen demand but the total extent of damage is not known. Deposition of the material, like a fine, flocculent peat moss, on beaches has been noted.

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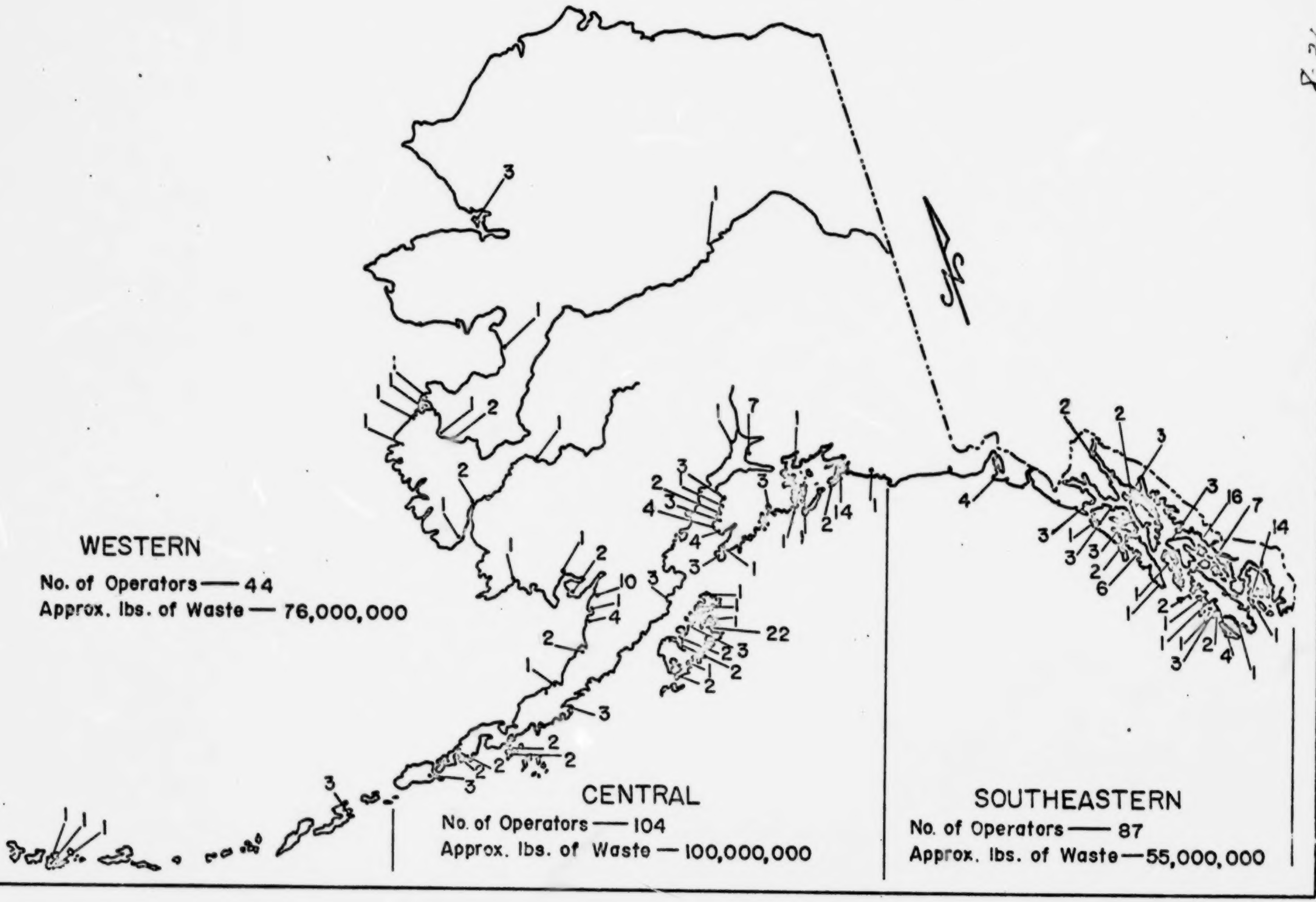
ALASKA-WIDE SEAFOOD PROCESSING WASTES

Figure 1

LOCATIONS OF SEAFOOD PROCESSORS IN ALASKA


WESTERN
No. of Operators — 44
Approx. lbs. of Waste — 76,000,000
CENTRAL
No. of Operators — 104
Approx. lbs. of Waste — 100,000,000
SOUTHEASTERN
No. of Operators — 87
Approx. lbs. of Waste — 55,000,000

ALASKA-WIDE SEAFOOD PROCESSING WASTES

I. INTRODUCTION

The purpose of this report is to draw attention to the vast amount of seafood wastes entering Alaskan waters, (see figure 1), point out present and developing pollution problems and make recommendations for action to abate these problems. The data used in this report are taken from Alaska Department of Fish and Game Statistical Leaflets Number 10 and 11. Further information on seafood waste utilization was obtained from other publications, (see bibliography). No detailed surveys or engineering studies were carried out for the preparation of this report.

The authority for this study is the Federal Water Pollution Control Act, as ammended (33 U.S.C. 466 et seq.).

Nearly all of Alaska's coastal waters still retain the pristine characteristics which are so desireable for the uses they support. In some isolated cases water quality has deteriorated due to poor management. Other areas are developing potential problems. It is toward the elimination of these present and potential problems that this study is directed.

II. SUMMARY OF IMMEDIATE POLLUTION CONTROL NEEDS

(Priority indicated by number in parenthesis).

Waste Treatment Area	Responsibility	Need	Relative Priority
Statewide	Seafood Processors	Primary treatment of sanitary sewage and chlorination of effluent.	(A)
Statewide	Seafood Processors	Collection and adequate treatment of seafood processing waste.	(B)

Institutional Practices Required:

1. The State of Alaska is proceeding to adopt standards as required by the Federal Water Pollution Control Act for Alaskan waters. These standards should clearly recognize Alaska's position as a major producer of commercial seafoods, and an area with great recreational potential.

2. The State of Alaska ought to consider legislation to provide for State participation in grants for the construction of sewage treatment works, where necessary.

3. Provisions should be made to expand the staff of the Alaska State Department of Health and Welfare to facilitate surveillance of the seafood processing industry.

Research:

1. Research by the seafood processing industry and the Bureau of Commercial Fisheries and the FWPCA to provide effective and economical ways of removing processing wastes and, if possible, means for their efficient utilization in the form of some fishery by-products of economic value.

III. PROBLEM AREAS AND IMMEDIATE NEEDS

During the last year for which statistics are available (1965), a total of 235 seafood processors were operating in Alaskan waters.

The Southeastern region (see figure 1) contained 87 operators and produced approximately 55 million pounds of seafood waste. One hundred-four operators were active in the central region where approximately 100 million pounds of seafood waste were produced. Forty-four operators were active in the western region where 76 million pounds of waste were produced.

The total seafood waste from Alaskan waters was approximately 281 million pounds (140,500 tons). About 50% of this waste was produced during the peak of the salmon canning season (mid - June to mid - September). Shrimp and crab waste is generally produced throughout the year.

Figure 1 shows the distributions of the various seafood processors. It is apparent that there is a wide diversity in the locations of many of the operators, but also there are several sites where a number of operators are located (Kodiak (22), Wrangell (16) and Ketchikan (4). These areas constitute the major actual and emminent problem areas within the state. Kodiak harbor has already experienced a severe degradation of water quality within the harbor due to waste discharge from the seafood industries.

Extremely high water quality is required by the uses that characterize the waters of Alaska. Production of anadromous fish, shellfish propagation, and recreational and aesthetic opportunities are curtailed, made more costly or eliminated by the existance of pollution by the seafood processing industry. In addition, present waste disposal practices create unfavorable conditions for the industry itself and could disrupt normal operations, particularly where several processors utilize the same receiving waters for waste discharge. The following actions are necessary in order to protect the use and quality of Alaskan Coastal waters.

1. Sanitary Waste Disposal Systems

Almost without exception, seafood processing facilities operating in Alaska lack adequate sanitary sewage facilities. Due to the variations in processing sites and numbers of employees (6-150), the impact of each processor on the receiving waters should be determined. State and Federal water quality standards should determine the degree of treatment required.

2. Solid Waste Disposal from Seafood Processors

Because of the number of sites used in seafood processing spread over a variety of geographic and climatic regions, there is, at present, no single method which could effectively be used for the recovery and disposal of seafood wastes. Each processing site should be examined to determine the degree of treatment necessary, the need for solids removal, and the possibilities for utilizing the waste materials.

IV. COST OF IMMEDIATE POLLUTION ABATEMENT

At the present time, raw domestic sewage is being discharged directly into the receiving waters from virtually all of the seafood processors. In order to meet the minimum requirements of the water quality standards of the State of Alaska, some form of treatment will be necessary. Since the number of employees at the various processors ranges from 6-150, it seems that the most practical method for treatment of domestic wastes would be a small package treatment plant. These package plants would vary in size to accomodate the number of employees at each of the processing plants. If approximately 85% of the processors needed such facilities and an average $25,000 was expended per package plant, about $5,000,000 would need to be invested in treatment facilities for domestic wastes.

In addition to domestic sewage, it will also be necessary to remove processing wastes in some problem areas. Although there have been numerous attempts to develop methods of utilizing fish wastes in Alaska, none have proven successful to date. At the present, there is a Norwegian package plant available which has a production capacity of 50 tons per day. Considering that it takes about five parts of wet waste to produce one part of the finished product, such a plant could utilize all of the waste from a problem area. There are three large problem areas where such a package plant could be utilized. The package costs approximately $1,000,000. Besides the three major areas of concentration there are several smaller areas that would also need attention.

Since there are no methods suitable for these smaller areas they will need to develop a means of transporting their wastes into an area that can assimilate the wastes without a degradation in water quality.

Considering the three large package plants plus a means for transporting the wastes from the smaller processors, it is estimated that an expenditure of $5,000,000 will be necessary to properly handle the fish processing wastes.

V. RECENT PROGRESS IN POLLUTION CONTROL

Preliminary results of research in progress at the Ketchikan Technological Laboratory of the Bureau of Commercial Fisheries, indicate the technical feasibility of utilizing wastes from both fish and shellfish to produce a fish protein concentrate suitable for use in animal feeding.

Data has been accumulated regarding process efficiencies, construction and operation costs, feeding experiments and market potential. Work is also progressing in the development of package plants suitable for the seasonal operations which are characteristic of much of the industry in Alaskan waters.

VI. BACKGROUND

A. Pertinent Coastal Characteristics

The Alaska Coast line associated with this study drains an area of approximately 500,000 square miles. So irregular is its boundary that if superimposed upon the lower 48 it would stretch from the Florida coast to California and from Michigan to Mexico.

Its nearly 32,000 miles of coast line exceeds the world's circumference.

The Pacific Mountain System defines the southern border of Alaska rising from the Gulf of Alaska and the Northern Pacific Ocean. The system continues in an arc across the top of the Gulf of Alaska sending off two spurs as its axis rotates west and southward. The coastal spur contains the St. Elias Range and the Chugach and Kenai Mountains where it dips into the sea to reappear as Kodiak Island at its southwestern tip. The main spur forms the cresent of the Alaska Peninsula and Aleutian Islands chain. Between these spurs lie the inland waterways of Southeast Alaska, the Wrangell Mountains, the Copper River Plateau, the Talkeetna Mountains, the Susitna Lowlands and Cook Inlet. Beyond the mountains lies a broad expanse of lowlands, plains and rolling highlands. Its drainage system - the Yukon, Kuskokwim, Porcupine, Tanana and Koyukuk Rivers - empties into the Bering Sea. Jutting out from the northwest corner of this region is the Seward Peninsula which reaches out toward Siberia. To the north lies the Brooks Range.

The climate of Alaska is a product of several physiographic features. The first of these is the general east-west main mountain system rising abruptly from the sea to heights of 19,000 feet. Secondly, Alaska is bounded by the Arctic Ocean to the north, the Bering Sea to the west and the gulf of Alaska and the North Pacific Ocean on the south. Its southeastern and southern coasts are bathed by the Japanese Current. Finally, Alaska's high northerly latitude is a basic factor in the determination of its climate.
As a result of these features, precipitation ranges from more than 150 inches per year in the southeast to 5-20 inches in the interior.

Temperature gradients are likewise strongly differentiated. The southern coastal strip is characterized by cool summers and mild winters while the interior is subject to great extremes (-60° F. to +90° F.).

Four major zones of vegetation can be defined. The seaward slopes of the southeast produce dense forests restricted to a narrow belt reaching to 2500 feet altitude. Within this belt there are approximately 16 million acres of forest predominantly hemlock and sitka spruce. The interior forest zone contains an estimated 125 million acres limited to the better drained valley floors. The predominant species are black and white spruce, birch, aspen and poplar. The grassland zone, approximately 100 million acres, covers the lower Alaska Peninsula and the Aleution Islands. Finally, 100 million acres of treeless Arctic slope and coastal lands constitute the tundra zone. In each of these zones there is an unmeasured amount of barren surface, muskeg and ice.

The total population of Alaska is approximately 265,000. Seventy percent of this population live in the coastal area. Population centers include Anchorage (102,000), Fairbanks (45,000), Juneau (12,400), Ketchikan (11,500), Wrangle-Petersburg (5000), Sitka (8225), Kodiak (9000), Bethel (7240), Nome (6613) and Kotzebue (4000). Of these only Fairbanks lies in the interior. To further delineate, approximately 132,000 people live along the central (see figure 1) coast, 39,000 along the southeastern coast and 17,000 along the western coast. It is rather unique that these population centers are not a product of Alaska's present economy but rather a result of her past economy.

The present economy of the coast is dependent upon commercial fishing, petroleum, timber and tourism. Unfortunately these industries do not always find complete compatability. Domestic sewage, wastes from wood products manufacturing and spillage from petroleum operations tend to reduce the water quality. It is rather paradoxical that fishing, the leading industry, cannot tolerate such a reduction in water quality nor can tourism tolerate a reduction in the esthetic quality of the area.

B. Present Water Quality Problems

1. Domestic Pollution

At the present time domestic sewage from the seafood processing plants is being discharged directly into the coastal waters. The number of employees at the various plants range from 6 to 150. Although the dilution available is practically infinite, Alaska's water quality standards do not allow the discharge of solids into receiving streams.

2. Wastes From Seafood Processing Plants

Heads, shells, vicera etc. from processing plants are discharged directly into the receiving waters. In most instances these wastes are dispersed by tides and wind and removed by scavengers or decomposed without causing a pollutional problem. However, in some congested areas in restricted bays this refuse has become a problem. At present such areas are solving their problems by barging the waste into the open sea or by grinding the wastes before discharging them into the receiving waters.

3. Low Dissolved Oxygen

Kodiak: In the past dissolved oxygen concentrations within the vicinity of the 22 processing plants near Kodiak has been reduced to the extent that the water could not be used in crab holding tanks. This condition did not exist during the 1966 season probably due to a poor crabbing season. However, it is a problem that will reappear when fishing returns to normal.

Approved practices which will either remove the wastes from the water completely or deliver them to areas in the sea that can assimilate them adequately will need to be initiated before the full potential of the coastal area can be realized.

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STATEWIDE FOREST AND MINING INDUSTRIES

STATEWIDE FOREST AND MINING INDUSTRIES

I. INTRODUCTION

The purpose of this summary is to describe and evaluate water pollution caused by mining and timber harvesting in the State of Alaska. Of necessity, the description will be in broad terms, and generalities will be resorted to in evaluating the seriousness of the pollution problem and courses of action to prevent or reduce pollution.

Recommendations presented here are based on studies done in Alaska (McNeil and Ahnell, 1964; Bishop, 1967) and in other parts of the United States (Dunford and Weitzman, 1955; Irvin, 1967; Eschner and Larmoyeux, 1963; Calhoun and Seeley, 1963; and Albert and Spector, 1955). All the cited works dealt with the effects of logging, chiefly siltation, on aquatic life. However, similar results arise during placer mining and also have an adverse effect on aquatic life.

Although pollution caused by mining and timber operations in Alaska now is minor, planned future expansion of these industries will pose serious problems unless methods of prevention are developed and enforced in anticipation of actual pollution. Public Law 84-660 entitled Federal Water Pollution Control Act clearly stipulates that any activity that is deleterious to stream use shall constitute pollution. Moreover, proposed standards for Water Pollution Control in the State of Alaska state that sediment that adversely affects fish life or interferes with water treatment is considered pollution. A statement in Alaska's Statutes, Section 46.05.230, presently excludes siltation caused by placer mining and gravel washing as pollution. This statement must be removed if Alaska's Water Quality Standards are to comply with the Water Quality Act of 1965. Background of this statement is that many Alaskan streams are naturally silt laden. However, the natural silt apparently does not preclude anodromous and

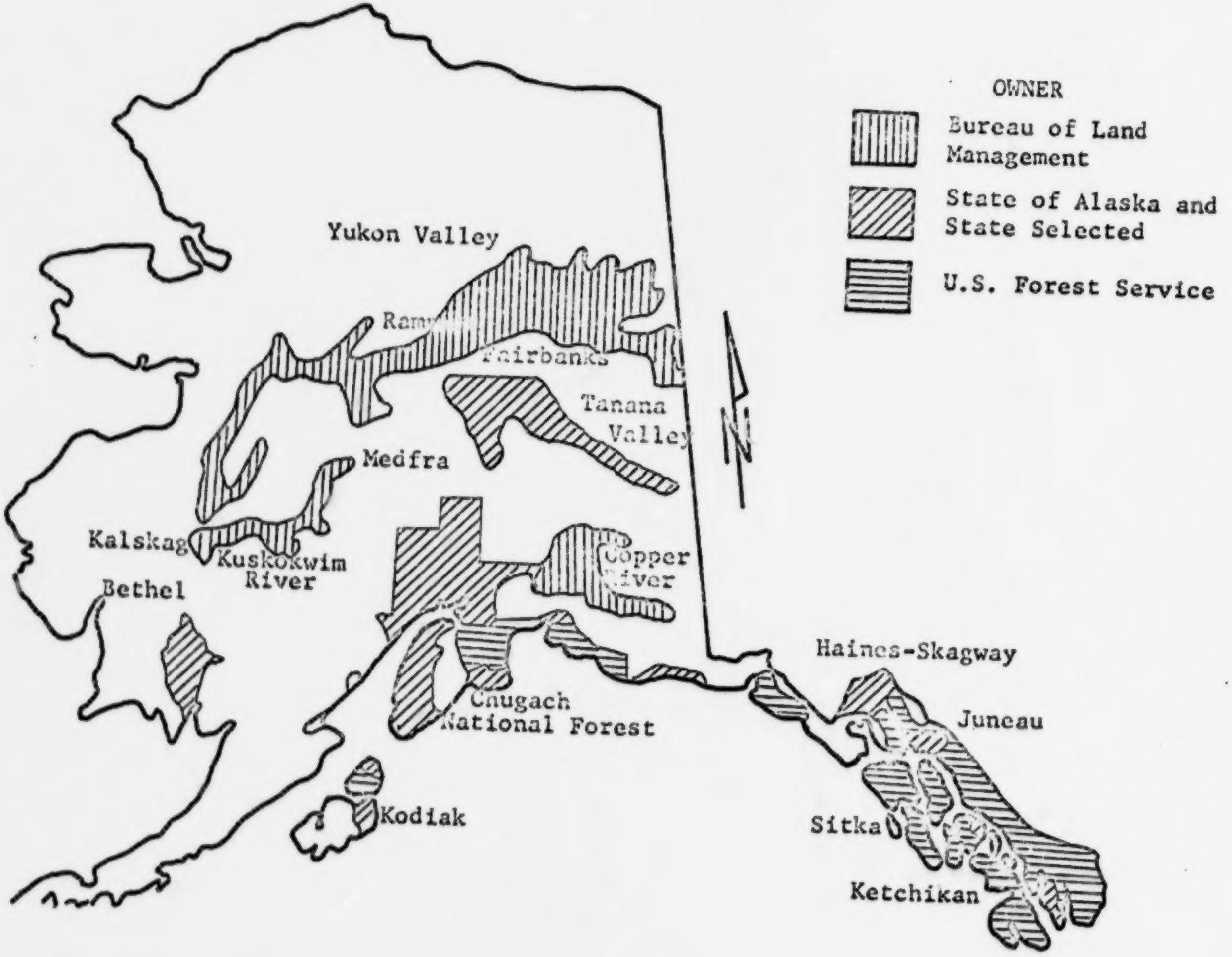
OWNER
Bureau of Land Management
State of Alaska and State Selected
U.S. Forest Service
Yukon Valley
Ram
Fairbanks
Tanana Valley
Medfra
Kalskag
Kuskokwim River
Bethel
Copper River
Chugach National Forest
Kodiak
Haines-Skagway
Juneau
Sitka
Ketchikan

Figure 1 - Commercial forests in Alaska (Haring and Massie, 1966).

other fish use of these streams, whereas man-made silt apparently does so. Further studies in this problem area, including possible synergistic effects, are desirable.

Since recommendations presented in the references cited earlier meet these requirements, executing these recommendations is justified. However, the Alaska Water Laboratory feels that research must be continued, or initiated where needed, to provide answers to problems of pollution associated with the mining and timber industry throughout the State of Alaska.

II. SUMMARY OF MAJOR POLLUTION PROBLEMS, COSTS OF ABATEMENT, AND RESPONSIBLE AGENCIES

At present, pollution arising from mining and logging is minimal simply because both these industries are operating far below their ultimate capability based on the extent of the total resource. Logging of any magnitude is carried on only in Southeastern Alaska and is supplying logs for pulp mills at Ketchikan and Sitka; the only other activities are small assorted sawmills scattered throughout the State (Rogers, 1962, p. 145). The chief polluting agent associated with logging is siltation which damages spawning and nursery gravels. Active mining consists of one underground mine and several minor strip or placer operations (Rogers, 1962, p. 145) although the Division of Mines and Minerals lists 182 active (including prospecting) mines and four coal stripping operations. Siltation is the principal polluting agent associated with mining, especially placers. Another possible source of pollution from mines is chemical reagents introduced by ore treatment of lode mining operations.

Figure 1 gives the general location of forests in Alaska where commercial timber operations are possible based on the existing resource. Nearly all timber resources are owned by government agencies, either State or Federal. Although logging in Southeastern Alaska is progressing, the total cut is far below the allowable cut on a sustained yield basis (Haring and Massie, 1966). Table 1 gives the programmed requirements for timber in Southeastern Alaska and illustrates that pulp mills are the principal consumers of timber.

Timber in interior Alaska is scarcely being logged at this time although several million acres of commercial timber are available. Table 2 shows the total interior timber resource.

Pollution control associated with logging consists chiefly in adhering to good logging methods and proper siting of logging and skid roads. Dunford and Weitzman (1955) conclude that total road mileage can be substantially reduced by careful planning. Eschner and Larmoyeux (1963) conclude that careful logging methods greatly reduced the sediment load of streams draining the logged watershed. In a survey of logging damage to California streams, Calhoun and Seeley (1963) concluded that careful logging could prevent siltation and that the main incentive was a willingness on the part of operators to be careful. It apparently costs no more to log by acceptable methods and prevent damage than to cause wholesale, irreparable damage to streams and watersheds.

Pollution caused by mining is now negligible although it could be a serious problem in the future because Alaska has extensive deposits of many minerals. The extent and location of 21 metallic and 9 nonmetallic minerals are discussed in the Rampart Dam Report (1965). Some of these are extensive and many need only a favorable economic climate to be developed with attendant pollution hazards.

TABLE 1

PROGRAMMED ANNUAL TIMBER REQUIREMENTS OF MANUFACTURERS IN THE TONGASS NATIONAL FOREST AREA, AS OF 1966-1967, (From Haring and Massie, 1966)

Company	Annual Requirement (million bd. ft.)
Ketchikan Pulp Company	220
Alaska Lumber and Pulp Company	140
*Pacific Northern Timber Company	70
Ketchikan Spruce Mills	25
Wrangell Lumber Company	20
Metlakatla Mill	20
Columbia Lumber Company	10
Sitka Sawmill	10
*Other	15
	530

* Planned Operations.

SOURCE: U.S. Forest Service, Juneau

TABLE 2
SUMMARY OF FOREST RESOURCE CHARACTERISTICS IN INTERIOR ALASKA AS OF 1965
(From Haring and Massie, 1966)

Resource Characteristic	Copper River Valley	Tanana River Valley	Yukon River Valley	Kuskokwim River Valley	Total Interior Alaska*
Ownership of Forest Land	Mainly Federal B.L.M., some State and private	Primarily state easily accessible private; Federal - BLM in non-accessible places	Federal - B.L.M.	Federal - B.L.M.	——
Commercial Forest Land	Approximately 1 mil. acres	Valley - 2 mil. acres Readily accessible - 1 mil. acres	Unknown, estimated at 10,000 sq. mi. forest area.	100,000 acres plus adjacent to river approx. 68,000 acres.	Unknown, but estimated at over 3.1 mil. acres.
Species Composition	Mainly White Spruce	White Spruce 60% Hardwood 40%	Mainly White Spruce	Primarily White Spruce; some Birch, Aspen and Cottonwood	——
Commercial Timber Volume (bil. bd. ft.)	1	Valley 7 Readily accessible 4	Unknown (estimated potential±10)	Valley .780 Adjacent to river .365	Unknown, but estimated in excess of 18.78
Estimated Allowable annual Cut (mil. b. ft.)	15	Valley 90 Readily accessible 45	Unknown	Valley 6½ Adjacent to river 4	Unknown, but estimated in excess of 111.5

* Based on major river valleys only

SOURCES: U.S. Forest Service, U.S. Bureau of Land Management and Alaska State Division of Lands.

TABLE 3
PRODUCTION OF MAJOR COMMODITIES
ANNUAL REPORT, DIVISION OF MINES AND MINERALS, 1965
DOLLAR VALUES (THOUSANDS)

Year	Gold	Mercury	Coal
1950	$10,125	$ ---	$3,033
1951	8,387	---	3,767
1952	8,420	6	5,779
1953	8,882	8	8,452
1954	8,699	277	6,442
1955	8,725	12	5,759
1956	7,325	853	6,374
1957	7,541	1,349	7,296
1958	6,525	774	6,931
1959	6,262	851	6,869
1960	5,887	940	6,318
1961	3,998	816	5,868
1962	5,784	712	6,409
1963	3,485	76	5,910
1964	2,045	95	5,008
1965	1,505	104	5,878

Figure 2 (A), (B), and (C) shows the location of major deposits of 14 metallic and industrial minerals (Cobb, 1960, 1962, and 1964).

Most damage to streams and associated biota, caused by mining operations, has already occurred as a result of extensive mining during the early part of this century. At present, only a few small mines are operating; hence, pollution is minimal and confined to small local areas. Gravel and coal washing are the largest contributors to pollution at present and this damage could be prevented by using settling basins to trap silt before the wash water is discharged to a stream. Although Alaska has extensive coal deposits in several parts of the state, only two fields are presently being mined, the Nenana and Matanuska fields.

III. IMMEDIATE CONTROL NEEDS

Although Alaska has extensive timber and mineral reserves, neither industry is being operated at potential capacity, chiefly because of economics associated with each resource. The principle timber reserves are the spruce and hemlock forests of southeastern and central coasts of the state. Virtually all of this timber is controlled by the U.S. Forest Service and logging of this timber will be under their supervision. With the present area of logging, pollution is not serious although local siltation of streams does occur. However, observations by Forest Service biologists (Sheriden and McNeil, 1967) suggest siltation of spawning beds caused by logging operations is temporary because this silt is flushed out during flood stages of each stream. These conditions may not always hold and permanent silting causes destruction of spawning beds as described by Irwin (1967) and McNeil and Ahnell (1964). In any event, it is

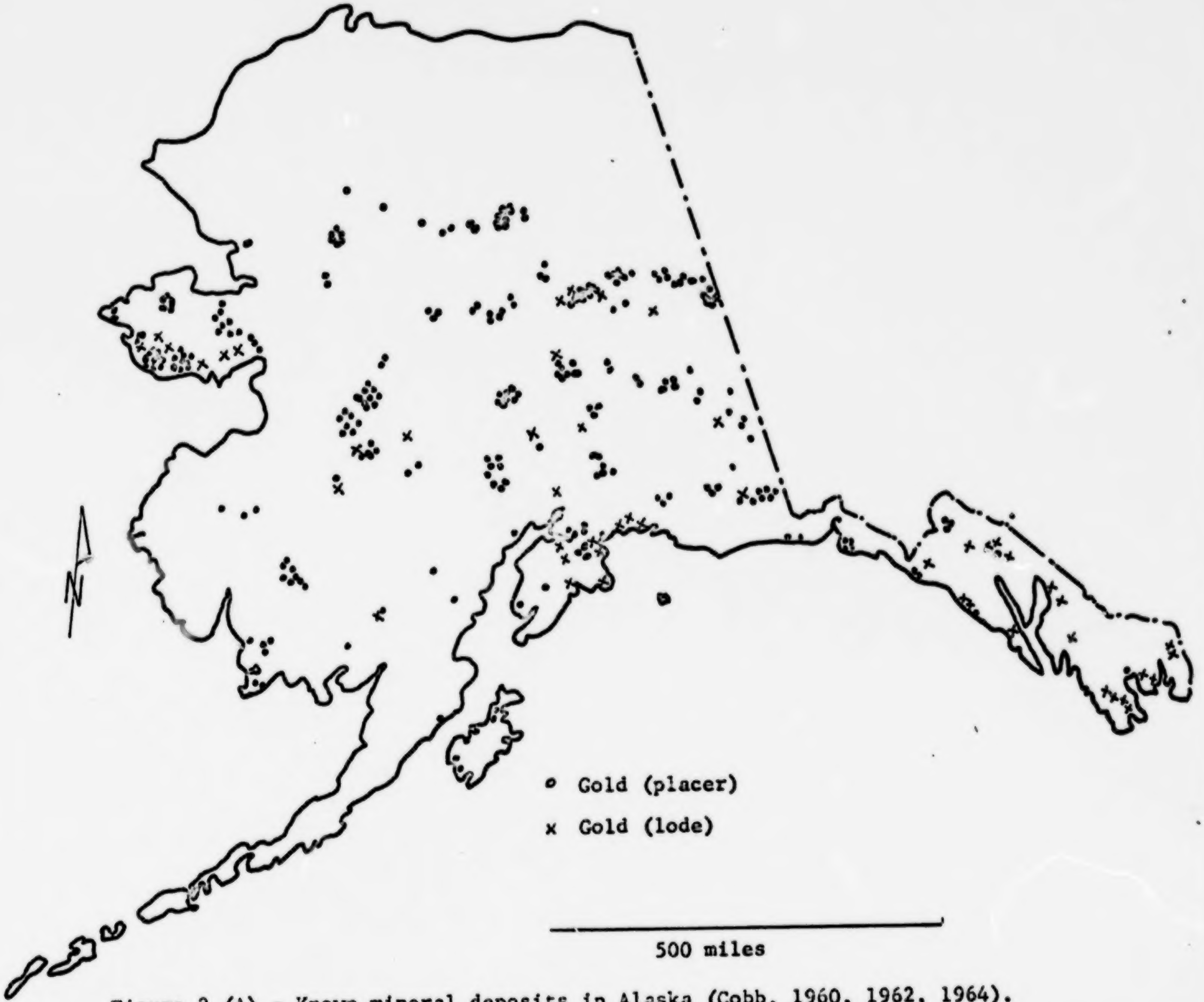
Gold (placer)
Gold (lode)
500 miles

Figure 2 (A) - Known mineral deposits in Alaska (Cobb, 1960, 1962, 1964).

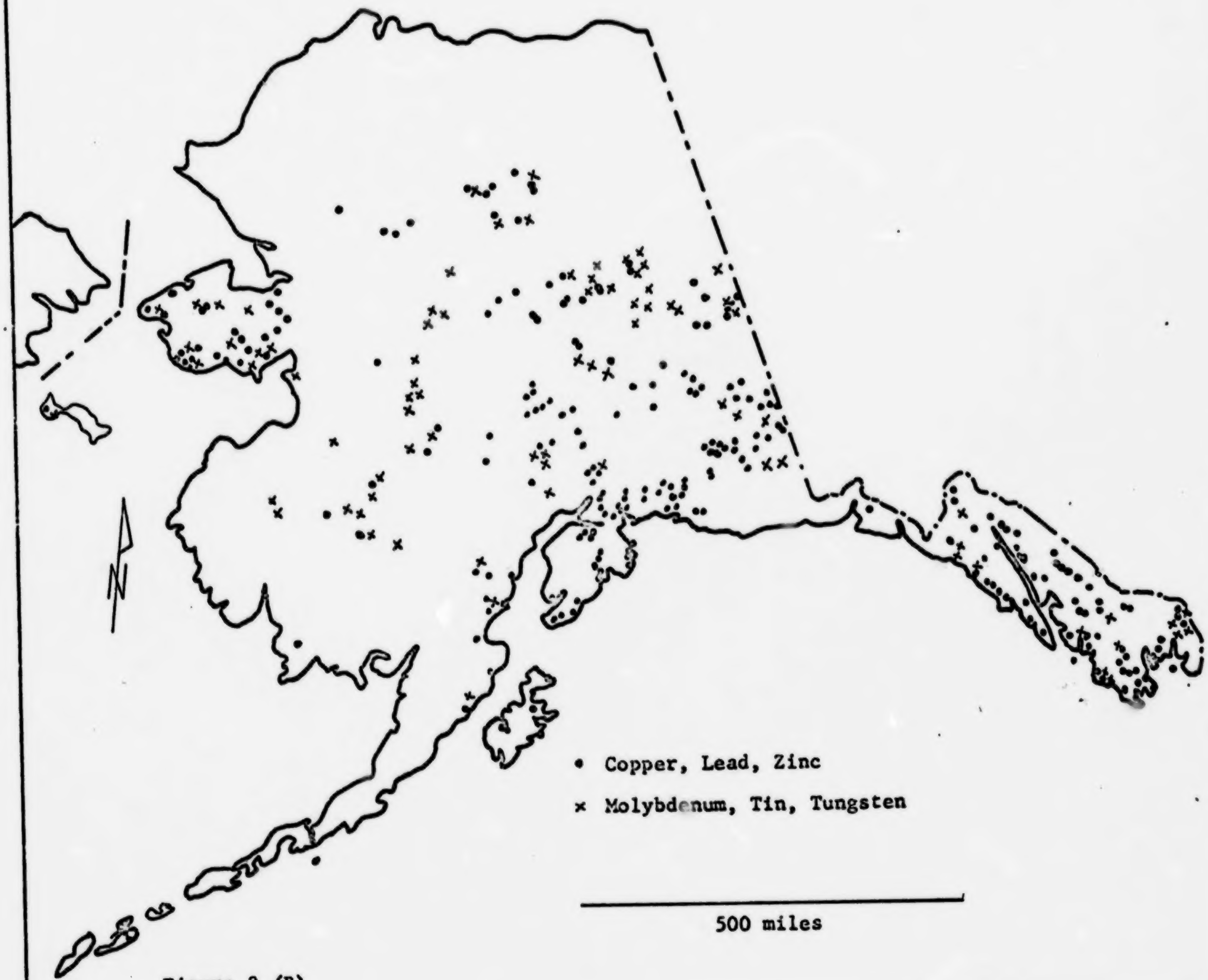
• Copper, Lead, Zinc
× Molybdenum, Tin, Tungsten
500 miles
N

Figure 2 (B)

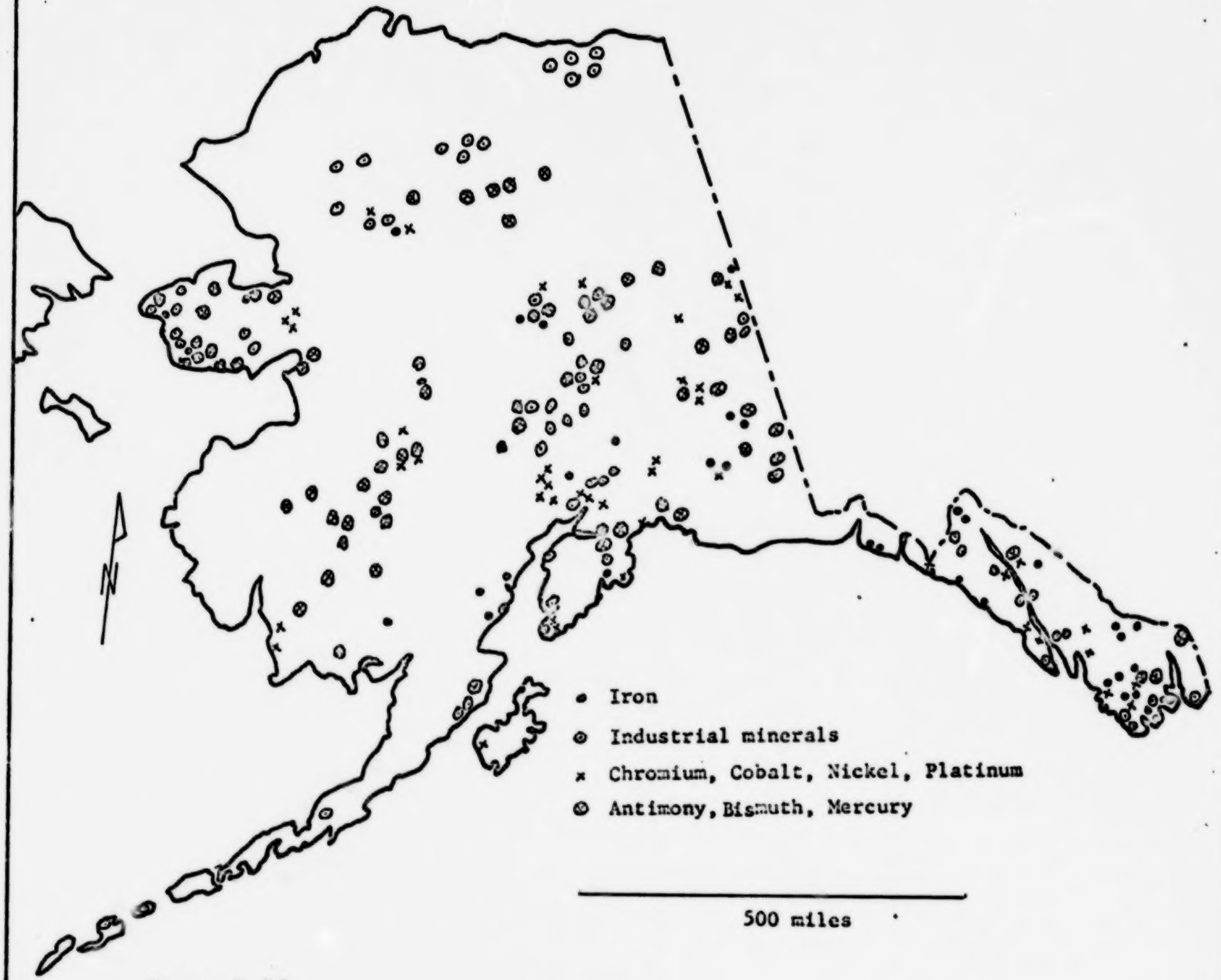
• Iron
⊙ Industrial minerals
× Chromium, Cobalt, Nickel, Platinum
⊗ Antimony, Bismuth, Mercury
500 miles

Figure 2 (C)

desirable to reduce silting to a minimum to preserve original spawning bed conditions. Properly laid out logging roads and logging by approved methods can prevent damage to streams by controlling erosion associated with timber removal. Approved logging methods are available; it is only a matter of getting loggers to use these methods under supervision of the Forest Service.

A definite figure for the forest resource of interior forests is nonexistent because these forests have never been inventoried. Haring and Massie (1966) present estimates that out of 130 million acres classified as forests in the state, 45 million can be designated as being commercial forests. Subtracting a total of 5.7 million acres of coastal forest from the total leaves 38.8 million acres of commercial forests in interior Alaska, a huge area by any reckoning. These forests, consisting chiefly of white spruce, aspen, and birch as marketable species, are generally confined to lowlands and adjacent slopes of the Yukon, Tanana, Copper, Kuskokwim, and Susitna valleys. Present logging of these vast forests is practically zero except for local use for rough lumber and house logs. The future of these forests will depend on developing markets for the wood product that can be furnished, mostly pulp (Haring and Massie, 1966).

Pollution caused by timber harvesting of interior forests can be placed at nearly zero because of the nonexistence of large scale operations. If large scale logging becomes established, pollution could still be minimal if proper logging methods are used. Nearly all interior forests are controlled by the State or the Bureau of Land Management; hence, these agencies can exercise close supervision of any logging operation. Another factor that would tend to mitigate siltation is flat terrain on which most of the commercial forests grow. Such low relief would prevent erosion because of extremely low stream gradients. The absence of intense rainfall and total low annual precipitation would also reduce siltation from logging operations. A possible complicating element might be permafrost. However, commercial timber does not grow where the soil is frozen; therefore, such effects could be neglected except where access roads might cross permafrost areas. Proper planning of road systems would prevent pollution similarly to that described for coastal forests.

Control needs associated with timber harvesting can be summarized by stating that pollution now is insignificant, and where it occurs it can be controlled by using approved logging methods supervised by whomever controls the forest. Expanding present operations to include interior Alaskan forests is dependent on developing markets and economic conditions. Research on effects of logging should be continued in coastal forests and initiated for interior forests to collect data with which to establish guidelines to permit economical harvesting of timber resources without damage to the resource base.

Although insecticides such as DDT have been shown to be deleterious to aquatic life (Reed, 1966), future pollution from this agent will be minimal. All governmental agencies have been instructed not to use chlorinated hydrocarbons as insecticides on government lands.[21] Since nearly all forest lands are in Federal agencies, this prevents widespread use of persistent insecticides. Where local control is required, melathion, a nonpersistent agent, is being substituted for chlorinated hydrocarbons.

Mining is considered by many to be an important industry in Alaska. This may have been true in the past and will probably be true in the future; however, at present, mining is a very minor economic enterprise (except for oil). Table 3 shows how two commodities have declined in importance during a 15 year period. Coal production is stable. In the past, copper mining in Copper River area was important where $200 million dollars worth of copper was taken out in about 20 years (Rogers, 1962, p. 258).

Pollution controls to prevent damage from mining operations are not now urgent because of the low level of mining activity. Nevertheless, serious thought must be given to methods of control to prevent future damage should mining experience a revival to its former importance. Probably the greatest potential source of damage is siltation from placer, stripping, and gravel washing. Damage is chiefly to stream biota as sediment covers gravel beds, chokes some streams and generally interferes with stream ecology. Settling basins will prevent siltation if such basins can be proven to be economical. Mining engineers are of the opinion that sediment controls are unnecessary and would be uneconomical. Biologists, on the other hand, have ample evidence that placer mining is detrimental to stream life. Prolonged high turbidity tends to cause fatigue of gill tissues of adult fish and excludes light from bottom dwelling organisms (Stroud, 1967).

Settling basins appear to offer the cheapest preventive measure for controlling siltation. Two one-acre basins-in-series can be constructed for a cost of $1400, assuming no land clearing. Maintaining these basins would average at least one bulldozer hour per day @ $40/hr. to give $4,800 for a 120 day season. Assuming that 50,000 yd^3 of gravels were sluiced, this would cost about $\$0.12/yd^3$ of washed gravel. Such costs can be compared to typical costs of placer gold mining which ranges from \$0.13 to \$2.54/yd^3, depending on the size of the operations (Thomas, et al., 1959). Assuming \$0.12/yd^3 for pollution prevention, in 1965 it would have cost \$114,200 to prevent siltation for an industry whose annual value was \$1,354,000.[22] Using similar reasoning, it would now cost about \$2 million to prevent siltation caused by gravel washing operations.

It must be made feasible that miners and pollution control agencies can work together for the mutual welfare. Research and engineering studies are needed, both from an economic and conservation point of view, whereby unemotional solutions to such problems can be obtained. Cooley (1966) cites studies done by private research institutes who conclude that recreation and tourism are one of Alaska's most potential industries. Filling small streams - that now run clear and provide recreation - with mining debris will not attract visitors to Alaska.

Chemical contamination from milling operations associated with lode mining may increase if mining becomes more important. For example, a revaluation of the price of gold as a subsidy paid to U.S. gold mines would result in a dramatic increase in this source of pollution. Generally such activities try to recover any chemical that is used if it is worthwhile; however, any such milling operation must be monitored to prevent damage to the streams through accident, negligence, or irresponsibility. Milling operations usually produce considerable silt which must be disposed of in settling basins similar to those discussed for placer mining.

IV. BACKGROUND FOR RECOMMENDATIONS

A. Geography

Physical characteristics of Alaska - location, physiography, climate and plant growth - have played a major role in her history and economic development. These characteristics will continue to influence development and challenge ingenuity. Principal physical features will be sketched briefly to show their effect on natural resources and future potentials.

The total area of Alaska is 586,400 square miles, one-fifth the size of the Continental United States and is larger than the combined area of the three next largest states - Texas, California, and Montana. The boundary of Alaska is such that, if superimposed on the 48 continental states, it would stretch from the Florida coast to California's and from Minnesota's northern border to Mexico's. Its nearly 34,000 miles of coast line exceeds the world's circumference at the equator and includes more than half of all U.S. continental shelf.

The northernmost point of Alaska, like Norway's, is 1,250 miles from the North Pole. The southernmost point of Alaska's mainland is the same latitude as northern Ireland. On the west in the Bering Strait, Siberia is 56 miles away. On the east the State borders Canada for nearly 1,000 miles.

Five regions are geographically defined as follows (Fig. 3):

1. Southeast

This region consists of the islands and enclosed waters of the Alexander Archipelago and the adjacent Alaska mainland south and east of the Malaspina Glacier and the St. Elias Mountains. It is mountainous and much of the land area is covered by dense forest.

UNITED STATES
DEPARTMENT OF THE INTERIOR

ALASKA PHYSICAL FEATURES AND REGIONS

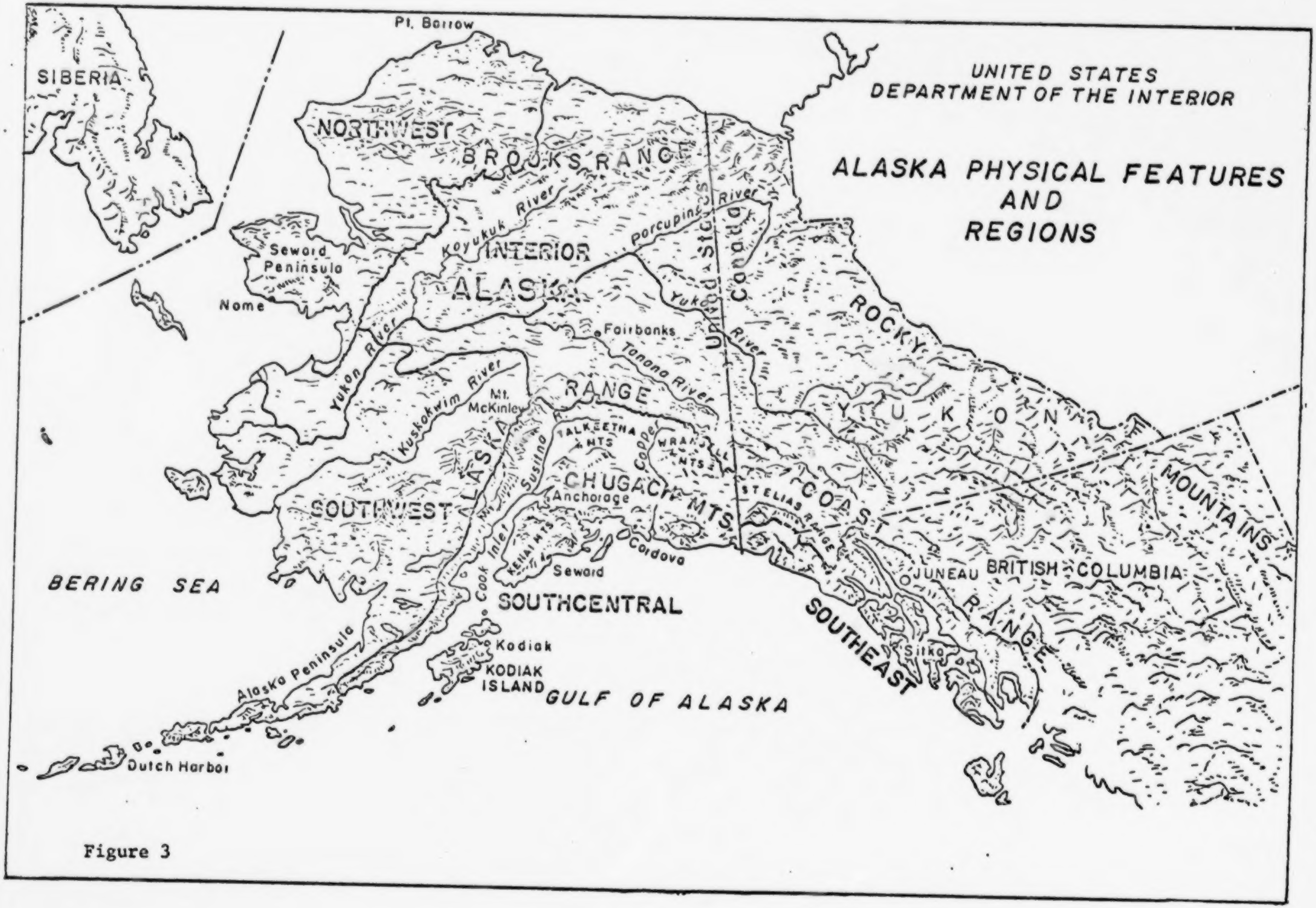
SIBERIA
Pt. Barrow
NORTHWEST
BROOKS RANGE
Koyukuk River
Porcupine River
INTERIOR
ALASKA
Seward Peninsula
Nome
Fairbanks
Yukon River
Tanana River
United States
Canada
ROCKY
YUKON
RANGE
Kuskokwim River
Mt. McKinley
ALASKA
Susitna
TALKEETNA MTS
Copper
WRANGELL MTS
CHUGACH MTS
Anchorage
ST ELIAS RANGE
COAST
MOUNTAINS
SOUTHWEST
Cook Inlet
KENAI MTS
Cordova
Seward
JUNEAU
BRITISH COLUMBIA
RANGE
BERING SEA
SOUTHCENTRAL
SOUTHEAST
Sitka
Alaska Peninsula
Kodiak
KODIAK ISLAND
GULF OF ALASKA
Dutch Harbor

Figure 3

9-18

2. Southcentral

This region combines Copper River basin, Susitna River basin, Cook Inlet drainage and its tributaries, the Alaska Peninsula drainage into Shelikof Strait, and Kodiak Island and adjacent islands.

3. Southwest

This region embraces the remainder of the Alaska Peninsula, Bristol Bay drainage, Kuskokwim River Basin, lower Yukon River basin (south of latitude 64° North), Aleutian Islands and islands of the Bering Sea south of latitude 62° North.

4. Interior

This region embraces the upper Yukon River basin north of latitude 64° North, Tanana River basin, Koyukuk River basin and that portion of the Arctic Slope east of Kupavak River basin. This last item does not belong naturally or logically in a region labeled as "Interior," but reflects boundaries drawn by the State Constitution for purposes of political representation, used by the U.S. Bureau of Census, and most executive agencies of the State government.

5. Northwest

This region embraces Seward Peninsula, Kotzebue Sound drainage, Arctic Slope west of and including Kupavak River basin, and islands of the Bering Sea north of latitude 62° North and Bering Strait.

B. Physiography

Alaska's topography is marked by two great mountain systems, as shown on Figure 3. The Brooks Range runs east and west above the Arctic Circle, and the Pacific Mountain System sweeps in a great arc through the southern part.

The Pacific Mountain System defines the southern border of Alaska, rising from the Gulf of Alaska and the North Pacific Ocean. It is a continuation of the continental system which swings northward through coastal British Columbia into Alaska as the Alexander Archipelago and Coast Range of southeastern Alaska. The system continues in an arc across the top of the Gulf of Alaska, sending off two spurs as its axis rotates west and southward. The coastal spur contains the St. Elias Range and Chugach and Kenai Mountains. It reappears from the sea as Kodiak Island as its southwestern tip. The main spur moves inland to form the crescent of the Alaska Range and the backbone of the Alaska Peninsula and Aleutian Islands chain. Between these two spurs lie the inland waterways of Southeast Alaska, Wrangell Mountains, Copper River Plateau, Talkeetna Mountains, Susitna Lowlands, and Cook Inlet.

Beyond these mountain barriers lies interior Alaska, a broad expanse of lowlands, plains, and gently rolling highlands. It enters Alaska from Yukon Territory and slopes in a southwesterly direction with its drainage system - the Yukon, Kuskokwim, Porcupine, Tanana, and Koyukuk Rivers - into the Bering Sea. Jutting out from the northwest corner of this region, but not actually a part of it, is the Seward Peninsula which reaches out toward Siberia. To the north of this region lies Brooks Range, a series of rugged highlands forming the northwestern extension of the Rocky Mountain system of the continent. Finally across the top of Alaska lie the foothills and coastal plains of the Arctic Slope.

C. Climate

Several dominant physiographic features influence the climate of Alaska. First is the general east-west trend of the main mountain systems (becoming southeast-northwest in the Panhandle region). The coast range mountains rise abruptly from the sea to heights of 6,000 to 19,000 feet, and behind them is the second major arc of the Alaska Range of similarly high peaks culminating in 20,300-foot Mt. McKinley. The Brooks Range constitutes the northern border of the Interior region. Secondly, Alaska is a large peninsula bounded by the Arctic Ocean on the north, the Bering Sea on the west, and the Gulf of Alaska and North Pacific Ocean on the south. Its southeastern and southern coasts are bathed by the Japan (or Kamchatka) Current. Prevailing winds are southerly (southeasterly in the winter and southwesterly in the summer). Finally, Alaska's high northerly latitude is a basic factor in the determination of climate, three-fourths being in the North Temperate Zone and the remainder in the Arctic.

Moisture-laden, southerly winds, warmed by the Japan Current, strike the first barrier of the Pacific mountain system and deposit moisture on seaward slopes. This wringing-out process is repeated as the somewhat drier and cooler air crosses the Alaska Range, and again when it reaches the Brooks Range. Therefore, moisture drawn from the Pacific Ocean is distributed over the major regions of Alaska in sharply contrasting amounts. The coastal area of the Pacific mountain system is characterized by extremely heavy annual precipitation, ranging from 60 inches to 150 inches in the extreme southeast section and considerably over 100 inches in the southcentral section. However, precipitation decreases rapidly a short distance inland from the coast. The city of Anchorage, just inside the Coast Range, has an average annual precipitation of 14 inches, while in the Interior region the range is from about 5 to 20 inches and on the Arctic Slope generally less than 5 inches.

Temperature gradients are likewise strongly differentiated by the interaction of sea influence and mountain barriers. The southern coastal strip is characterized by comparatively cool summers (mean average temperatures ranging in the mid-50°'s F.) and mild winters (mean average temperatures in the 30°'s F.). Despite its extreme northern situation, the Arctic Slope climate is moderated by the Arctic Ocean, its average summer temperatures ranging from the mid-thirties to the low fifties, and winter temperatures ranging from three to sixteen degrees below zero. It is in the Interior region, particularly in the upper Yukon basin, that the greatest extremes and most severe winters occur. The greater part of the region is isolated from the moderating influence of the ocean by the Brooks Range on the north and the Alaska and Coast Ranges to the south. The mean temperatures in winter generally hover from seventeen to forty degrees below zero and in summer rise into the upper sixties. Extreme low temperatures of 78 degrees below zero and high temperatures in excess of 100 have been recorded at Tanana and at Fort Yukon. Toward the Bering Sea, temperatures moderate.

A comparison of the average number of days a year with minimum temperatures of zero or lower indicates the relative severity of weather. This ranges from 2 days at Ketchikan and Sitka in the Southeastern region, to 132 days a year at Fort Yukon in the upper Yukon basin, and 170 days at Point Barrow in the Arctic Slope. The growing season ranges from 165 days at Ketchikan to only 17 days at Point Barrow. The season over the largest land area (the Interior region) ranges from 54 to 90 days. The extreme northern latitudes of most of Alaska produce a correspondingly marked difference between the length of summer and winter days. At Fairbanks, north of the Alaska Range, the sun rises at 9:58 A.M. and sets at 1:40 P.M. on December 21 and rises at 12:57 A.M. and sets at 11:48 P.M. on June 21. At Point Barrow the sun is not seen at all from late November until late January and there is continuous daylight from early May until early August.

D. Vegetation

Vegetative cover is a direct product of topography, climate, growing season, and day length. Four major zones can be defined on the basis of the predominant cover type. The seaward slopes of the Coast and Chugach ranges, with a generally moderate temperature and heavy rainfall, is covered by a dense forest restricted to a narrow belt from one to five miles wide (except where penetration extends inland along river drainages), and extends to about 2,500 feet above sea level. Within this belt are approximately 16 million acres of forest land, the northern and western extensions of the dense coastal forests of the Pacific Northwest. Predominant species are western hemlock and Sitka spruce. The Interior forest zone, containing an estimated 125 million acres of forest, is limited to the better drained valley floors, benches, rolling ground of the lowlands and the lower slopes of the ranges enclosing this region. These are extensions of the boreal forests which border the Arctic tundra. Predominant species are black and white spruce, Alaskan white birch, tamarack, aspen, cottonwood and balsam poplar. Stands are broken and scattered and growth is generally slow except on favored sites. The principal grassland zone, approximately 100 million acres, covers the lower Alaska Peninsula and the Aleutian Islands; other important grasslands of more limited extent also being found elsewhere. Finally, 100 million acres of the treeless Arctic Slope and coastal lands of the Interior region constitute the tundra zone, an area covered by sedges, mosses, lichens, small brush, and willows a few inches high, most underlain by permafrost.

Each of these major vegetative zones contains an unmeasured amount of barren surface, muskeg, and ice. Limited areas of land are suitable for tilling and other agricultural pursuits, but generally top soil is very shallow (averaging less than one inch over extensive areas) and humus decomposition is slow. Permafrost occurs from six to forty inches below the surface over much of the Interior.

E. Population

Alaska now has a total population of about 250,000 with two centers of concentration, Anchorage with 110,000 and Fairbanks with about 40,000 persons. A total of about 50,000 live in several smaller cities in southeastern Alaska, Juneau, Sitka, Petersburg, Haines, Skagway, Wrangell, and Ketchikan. Population forecasts for 1980, based on several assumptions such as increased electric power availability and continued oil expansion, indicate a population of about 452,000 (Rampart Dam Report, 1965). The greatest growth is predicted to be in the Anchorage and Fairbanks areas, as a result of petroleum activities in the former and mining and services in the latter.

F. Industry

Forest utilization will continue to be centered in coastal regions where merchantable timber is accessable and abundant. Pulp mills will consume most of the cut and the total annual cut will increase if a proposed pulp mill is built on Admiralty Island.

Timber industry of the interior is not expected to become important within the next 15 years (Rogers, 1962, p. 234). Absence of a suitable market for the products available is the chief deterent to developing a forest products industry to harvest interior forests. As long as similar wood products are available elsewhere at competitive prices, the transportation problem will continue to forestall development of a timber industry in interior Alaska within ten years.

Although mining as an industry is undergoing a depression in Alaska, the future may see a revival of mining activity. Alaska has many ore deposits and new intensive exploration will probably identify new mineralized areas and add to known ores. Of the known minerals, the most favorable future is for copper, iron, and coal (Cooley, 1966, p. 15). New technology, sources of power, and demand are all that are needed to stimulate the extraction of these minerals. A serious block to progress in mining in the state is the lack of sufficient knowledge of the geology. Intensified geologic mapping is expected to contribute many new ore deposits within a few years. Long term prospects are favorable because the geology of Alaska is similar to that in northern Canada where extensive producing mineral deposits occur (Cooley, 1966, p. 15).

Gold mining in Alaska has traditionally been thought of as an important industry, and many millions of dollars worth of gold have been produced. However, under the present economic conditions, the future of gold mining appears far from optimistic (Rogers, 1962, p. 227). Many known placer and lode deposits are unworked because the price of gold is simply too low to pay for mining the metal.

Reserves of other metallic minerals are largely unknown and the easily found deposits of economic worth have been mined. An exception is iron ore in southeastern Alaska; here reserves are sufficient to warrent development if suitable markets were available.

Alaska has vast reserves of coal north of the Brooks range as well as in other areas of the state. However, much of this fuel is low rank, which combined with remoteness of the deposits, reduces the demand. As other sources of energy become available in Alaska, the present demand for coal will probably decline unless other uses for coal are developed. It is unlikely that coal mining will expand in the next 10 years even with a moderate increase in population.

G. Water Uses

Timber harvesting is not a large consumer of water, its only use of water is for transporting sawlogs and storage prior to milling. Contamination of water by logging is chiefly by siltation of streams caused by careless logging methods.

Placer mining requires a dependable source of large volumes of water although quality of water is not critical. Where dredging is planned, Alaskan gravels and overburden must be thawed with circulating water. After thawing, silts and sands are removed by hydraulic methods that need large volumes of water and which produce large volumes of sediment. It is during this phase of placer mining that the most damage is done to streams and fisheries.

Milling of lode deposits does not require as much water as placer mining nor are as large volumes of silt produced. Mining engineers feel that silt derived from milling can be economically controlled because of the smaller volume and better topographic relationship of milling sites compared to placer operations.

Coal and gravel washing require large volumes of water and produces large volumes of silt. High quality is not required.

H. Pollution Control Measures

Pollution caused by logging and mining is primarily siltation of streams which may or may not be permanent, depending on the individual stream hydrology. A second source from mining might be chemicals introduced or derived from milling of ores.

Control of siltation caused by logging can be obtained by using approved logging methods that do not add to the overall cost of timber removal. Only two requirements need be met, (1) the desire to prevent damage and (2) properly supervised operations designed to get the job done economically with minimum damage. When Alaska became a state its constitution contained a natural resource article (Article VIII) that states that policy would be to "encourage the settlement of its land and development of its resources...for maximum use consistent with the public interests. The utilization, development, and conservation of all natural resources belonging to the State, including land and water, (was to be) for the maximum benefit of its people.... Whenever occurring in their natural state, fish, wildlife, and waters are reserved to the people for common use...replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses." (Rogers, 1962, p. 177-178). By this article Alaska retained its right to control the utilization of its resources for maximum benefit of its people. Such control can certainly be extended to aid in preventing pollution of streams by logging operations.

Siltation that results from placer mining, coal and gravel washing, and similar mining operations can be prevented by providing settling basins. Research or engineering studies might provide alternate methods to prevent siltation. In the past, little attention was given to the effects of mining on ecology and widespread damage was done. Although miners are reluctant to accept controls over their operations to prevent pollution, the article quoted earlier provides the state with a tool for enforcement. The state retains permanent mineral rights of all land that is sold and may retain permanent ownership of mineral lands where removal of minerals would interfere with surface rights (Cooley, 1966, p. 37). Moreover, the state can reject or restrict a mineral lease to insure that the mining operation does not interfere with the prime use of certain classified lands that includes public recreation and watersheds.

Through the foregoing provisions of the State government, the State has the power to control any mining operation that is detrimental to the public interest. What is required is the willingness on the part of all parties concerned to recognize that siltation is detrimental to long range stream use and that it can be prevented economically if operators are desirous of using preventative measures. It is sheer shortsightedness to wreak permanent damage to stream systems for a few thousand dollars worth of minerals. Moreover, it becomes ridiculous to refuse preventive measures even if they do reduce total profits. Outdoor recreation is becoming more profitable and this use of marginal mineral lands may be a better use than mineral extraction.

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OIL INDUSTRY

OIL INDUSTRY

I. INTRODUCTION

The purpose of this report is to examine and evaluate the sources and extent of pollution attributed to the developing industry in Alaska and to recommend actions designed to satisfy immediate control needs.

Oil has been known to exist in Alaska for over fifty years but it wasn't until 1957, when Richfield Oil Company completed the first commercially important oil well on the Kenai Peninsula, that the present era of development began. Following this discovery, oil and gas fields were discovered elsewhere and now, after 10 years a mature, integrated oil industry is firmly established in Alaska.

Discovery of oil and gas offshore in the Cook Inlet Basin prompted erection of permenent drilling and production platforms. Presently, six of these huge structures occupy sites between Kenai an Tyonek. Two more will be constructed this summer and prospects are for a total of 15 in the near future. Should oil be discovered in Cook Inlet south of Kalgin Island, the activity could again be doubled.

The attempt to develop a fail-safe offshore oil drilling program in Cook Inlet has taxed the best minds in the oil industry. Conditions, prevalent in the Inlet, are unlike any the industry has encountered elsewhere. Tidal currents reaching 8 knots, are driven by the second (up to 30 feet) highest tides in the world. During winter ice floes over two feet thick form.

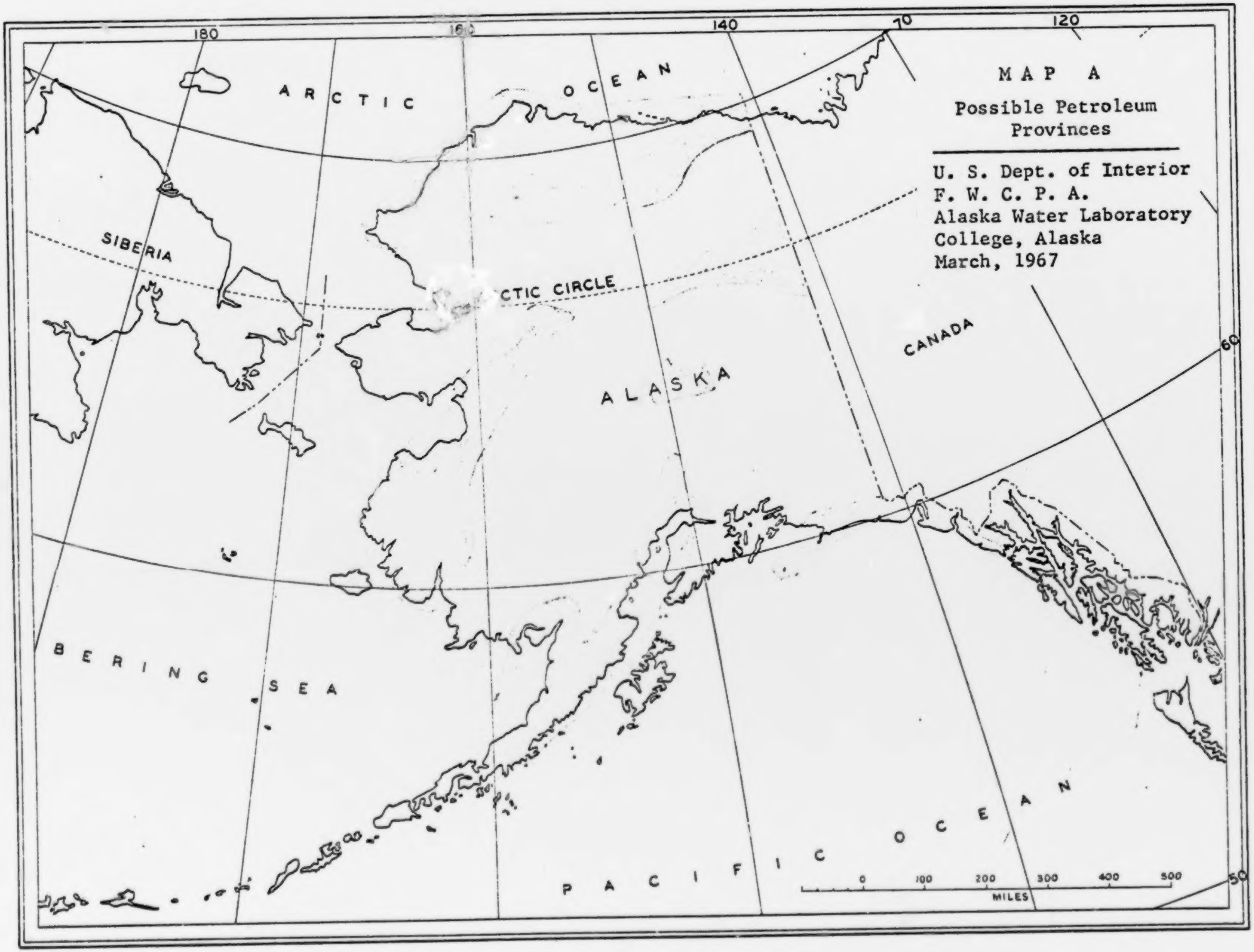
Establishing year-round operations under these conditions has been especially challenging. Despite all precautions, accidental oil spills from broken pipe lines have released large quantities of crude oil to the waters of Cook Inlet. Platform activity has reached the point where waste discharges of oily mixtures, refuse, and sewage have collectively become a pollution problem.

Accidental oil pipeline breaks, intentional oily discharges from well testing and workover, refuse in the form of mud sacks, plastic visqueen, pallet boards, and garbage have caused concern to fishermen whose nets became fouled, reducing fishing time and causing fishermen measurable economic loss. On occasion, plastic film tarps wrapped around boat propellers and terminated what otherwise might have been a successful fishing trip.

Wildlife personnel are concerned that offshore drilling operations will generate oily wastes, sufficient in quantity to disable and kill waterfowl and destroy productive clam beds. To date, no report of loss has been made; however, the possibility can be readily envisioned.

Oil company representatives are sensitive to oil spill complaints which charge negligence but lack supporting proof. The industry is aware that potential hazards exist and have openly discussed them with government officials. Future drilling, production, and transportation operations are certain to include techniques, presently unknown, to prevent oil pollution.

The recommendations included in this summary have been prepared without benefit of a detailed study. They are based on information supplied by the conservation agencies of the State of Alaska, U.S. Fish and Wildlife Service and informal discussions with participating oil companies.



MAP A

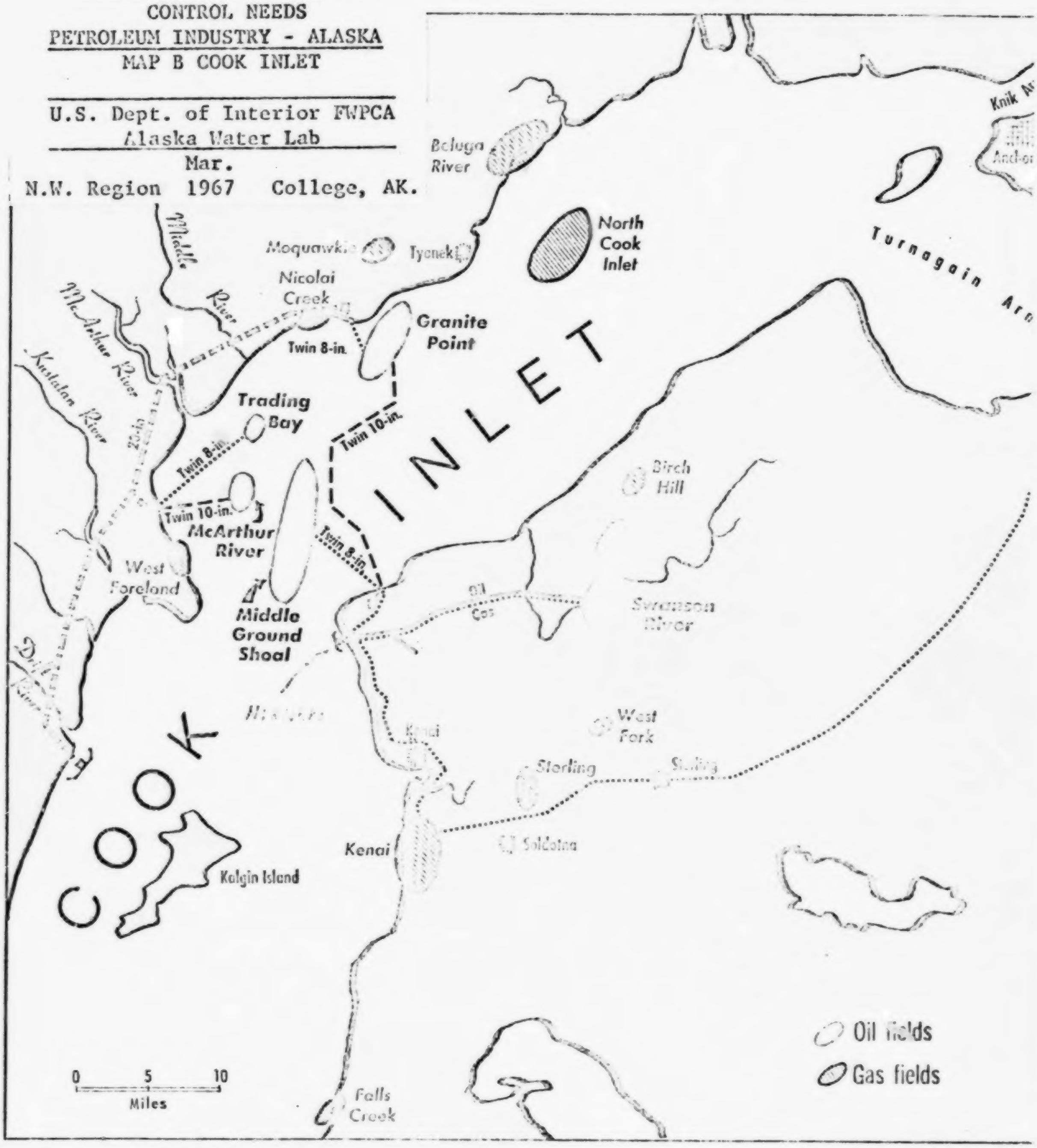
Possible Petroleum Provinces

U. S. Dept. of Interior
F. W. C. P. A.
Alaska Water Laboratory
College, Alaska
March, 1967

180
160
140
70
120
60
50
ARCTIC OCEAN
SIBERIA
ARCTIC CIRCLE
ALASKA
CANADA
BERING SEA
PACIFIC OCEAN
0
100
200
300
400
500
MILES

IMMEDIATE WATER POLLUTION
CONTROL NEEDS
PETROLEUM INDUSTRY - ALASKA
MAP B COOK INLET

U.S. Dept. of Interior FWPCA
Alaska Water Lab
N.W. Region Mar. 1967 College, AK.


Beluga River
Moquawkie
Tyonek
North Cook Inlet
Knik Arm
Anchorage
Turnagain Arm
Middle River
McArthur River
Kustatan River
Nicolai Creek
Twin 8-in.
Granite Point
Trading Bay
20-in.
Twin 8-in.
Twin 10-in.
Twin 10-in.
McArthur River
Twin 8-in.
West Foreland
Middle Ground Shoal
COOK INLET
Birch Hill
Oil
Gas
Swanson River
Drift River
Kenai
West Fork
Sterling
Sterling
Kenai
Soldotna
Kalgin Island
0 5 10
Miles
Falls Creek
Oil fields
Gas fields

Oil fields

Field	Number of Wells
Swanson River	56
Middle Ground Shoal	6
Granite Point	3
Trading Bay	1
McArthur River	1

COOK INLET
VICINITY MAP

The observed pollution of Cook Inlet by oil, is in violation of the Oil Pollution Act of 1924, as ammended by Public Law 89-551; The Refuse Act of 1899, and the State Water Pollution Control Act.

II. SUMMARY OF MAJOR POLLUTION PROBLEMS, COSTS OF ABATEMENT, AND RESPONSIBLE AGENCIES.

Source of Waste	Immediate Pollution Needs Control	Estimated Cost to Correct	Relative Priority
Drilling barges Cook Inlet	Collection and land disposal of oil contaminated leaks, spills, dumps, and slops.	$4.5-5,000,000	A
Drilling Platforms Cook Inlet	Collection and land disposal of oil contaminated leaks, spills, dumps, and slops.	$1.6-2,000,000	A
Terrestrial Drilling	Spent or contaminated mud disposal.	$50-100,000	A
Inlet pipeline failures	Better equip. design, leak collection system, and use of pollution prevention equipment.	$2-400,000	A
Harbor transfer spills	Prevention by use of better equipment and by inspection.	Not separable	A
Tanker deballasting	Policing only.	Not separable	B
	Future Pollution Needs Control		
Nikishka Terminal	Slop handling capacity for oil tankers.	$100,000	B
Drift River Terminal	Slop handling capacity for oil tankers.	$200,000	B
Various crude oil handling facilities along Cook Inlet shores	Oil well brine separation and disposal.	$100,000/Facility	B

Source of Waste	Future Pollution Needs Control	Estimated Cost to Correct	Relative Priority
Standard oil refinery	Design has abatement provisions built-in.	Not separable	C
Ammonia-Urea Plant	Design has abatement provisions built-in.	Not separable	C

III. IMMEDIATE CONTROL NEEDS

The following steps are recommended to eliminate the present oil pollution problem in Alaska, in order of relative priority:

A. Offshore activities; gather oily and solid wastes and place in a gondola or other type slop tank or barge. Haul to land base - pump inside ring levee - burn inflammables and land fill.

B. Onshore activities; control earthwork to prevent excessive erosion and stream siltation. Collect oily wastes to prevent ground and surface water contamination - burn inflammables and land fill.

C. Oil pipelining, better site analysis, preparation, and improved design using larger safety factors; use of pollution prevention equipment.

D. Harbor transfer; better design and housekeeping; accident prevention.

E. Tanker deballasting; adequate policing.

Accidents are difficult to prevent; but the use of adequate equipment, regular inspection, proper procedure, and necessary training would greatly reduce their numbers.

Many pollution instances are generally attributed to negligence, although the facts sometimes suggest deliberate acts.

One of the best preventive measures in any phase of the oil industry is regular surveillance by a state or federal enforcement agency. Enforcement in other regions has already proven beneficial to both the industry and to the public for the reason that many thousands of barrels of crude products have, as result of regular inspection, been prevented from polluting the environment.

IV. BACKGROUND FOR RECOMMENDATIONS

Population

The present and immediate future population [illegible] Alaska will have little effect on the oil industry since it will not constitute a large enough market.

Industry

The oil industry in Alaska is very young. The first pool in the Cook Inlet has been in production only since December 1965 and real pollution control needs for the oil industry lie in the future. As can be seen on Map A the area of the potential petroleum provinces is larger than that of Texas. Oil and gas has already been discovered in northern Alaska. Within 10 to 15 years Alaska could conceivably be passing Kansas and Oklahoma and heading for a spot among the top three producing states.

A. Drilling and Production

This year the Cook Inlet will have about 8 permanent platforms and 14-17 drilling barges. The Bristol Bay area will probably have one drilling barge. Drilling activity in the Inlet is responsible for most of the oil pollution problems. The entire industry is not using all the pollution preventive devices available and is not taking all possible preventive measures. Dumping waste, drilling muds, products from drill stem testing, and well swabing is a major source of oil pollution. Oilwell workover, when it becomes necessary, will be a future possible pollution source.

At present there are only about four operators drilling on land. One British Petroleum official said, "There's going to be a lot of oil to be found in Alaska and a lot of it will be found on the North Slope."

On some of the remote land based drilling sites the spent drilling mud and oil production, if any, is dumped with abandon and drains into rivers and streams, ruining their pristine qualities. Oil well brine disposal has, as yet, created no problem because it is pumped back into the ground at a horizon where it will not effect near surface aquifers.

One extreme hazard in drilling, testing, and production is the ever present possibility of an oil well blowout. A blowout occurs when a high pressure reservoir is punctured by a drilling string which is not surrounded by sufficient drilling mud to hold back the reservoir pressure. Once the high pressure fluid starts flowing out of the hole, it is almost uncontrollable. A blowout on an offshore drilling rig could conceivably cover the water surface with several hundred thousand barrels of oil. Blowout preventers are standard equipment and make the possibility of a blowout remote. No one conscious of the risks would allow it. However, the industry provides examples where blowouts have occurred even after thousands of dollars of blowout prevention equipment were properly installed and trained workers stood by the controls.

B. Exploration

Explosives used in seismic operations and exploration operations themselves, are well regulated by the State. However, in the past, dirt and other debris has been dozed into the State's waters. This practice is prohibited.

C. Pipelines

Keeping a crude oil pipeline intact within the Cook Inlet is one of the most difficult jobs in the world. The reasons for this are: (1) a boulder dotted bottom, (2) second highest tides in the world, (3) extreme tidal currents and ice flow up to 8 knots, and (4) depressions on the inlet floor. The risk of failure is so great that some companies prefer to build new shipping facilities on the west side of the Inlet rather than cross it and use existing terminals.

A leak has already occurred on the first pipeline in the Inlet. This leak was not detected immediately because the pressure loss was not sufficient to operate the automatic shutoff. Twenty-five to thirty barrels of crude were lost before the leak was detected and another 100 barrels were purposely lost (to the Inlet) in locating the leak.

D. Harbor Transfer

Several times in the past, oil pollution of Alaska's harbors has been caused by accidental spills during transfer between ship and shore. Most of these spills were caused by negligence and not by defective equipment. Several thousand gallons of oil products have been discharged into Alaska's harbor waters because of failure to close a cleanout valve.

E. Tanker Deballasting

Information from the Kenai pipeline people indicated that tanker deballasting was not a major source of pollution since only cleaned tanks were used to hold ballast water. The cleaning water (slops) is treated and discharged at the Nikishka terminal. The recent development of special burners to use water contaminated oil along with bunker C may eliminate the future need of slop treating facilities at crude oil terminals.

V. RECENT PROGRESS IN POLLUTION CONTROL

Oil Companies

Most of the recent oil pollution has been caused by accidents where gross amounts of oil have run onto surface waters. Resulting pollution from this source far outweighs that from any other cause. It is more difficult to control accidents than simple leaks or spills.

As a result of the complaints from the Fisheries people, most of the responsible oil companies are reportedly making every reasonable effort to prevent pollution. When possible they are barging all their wastes ashore for disposal.

Facilities are now set-up at the terminals of the Cook Inlet pipelines to handle brines from the crude oil when it becomes necessary.

State Agencies

Through conservation of natural resources, the Petroleum Division of the Department of Natural Resources prohibits loss of oil without notification. The Department of Health and Welfare has direct responsibility for the enforcement of the State statutes but it lacks funds for any effective surveillance-enforcement program. The Fish and Game Department acts in an advisory capacity only.

Federal Agencies

The U.S. Army Corps of Engineers is concerned with pollution only to the extent that it affects navigation. The main associated function here is to issue navigation permits. They also have the responsibility of enforcing the Refuse Act. of 1899. The U.S. Fish and Wildlife Service is allowed by law to comment on the navigation permits where Fish and Wildlife might be adversely effected. The U.S. Coast Guard has responsibility for enforcing the Oil Pollution Act of 1961 which deals with international waters only. The Federal Water Pollution Control Administration has direct responsibility for enforcing the Oil Pollution Act of 1924 and will act under the Federal Water Pollution Control Act of 1965.

VI. PETROCHEMICAL INDUSTRY'S WASTE WATERS

Waste water from the following sectors of the hydrocarbon industry is being, or will be, discharged into the Cook Inlet, or is being pumped back into the ground:

Source	Plant Size	Average Waste Water Flow MGD
Collier Carbon NH_3-Urea Plant (1968)	1,500T/D NH_3	0.814
Standard Oil Refinery	20,000 BPD	0.21
Swanson R., well brines	30,000 BPD	0.19
Ballast tank cleaning H_2O	less than 1 tanker/day	less than 0.01

Although Alaska has numerous streams that could be effected by the oil industry, we will consider only the Cook Inlet because this is where the immediate oil problem exists. Cook Inlet is the largest inlet in Alaska and most of the trade in Alaska passes through it. Its surface at its upper end is fresh water, fed from silt laden glacial streams, which changes to salt water at its entrance to the southwest. It probably carries more silt seaward than does the Mississippi River.

Some Alaskans think the Inlet has a low net flow and acts more like a stagnant basin than a drainage area. Oceanographic data is lacking and measures to get such information should be started because of the potential seriousness of future contamination.

The potential exists because there are at least three large natural gas fields in the Cook Inlet Area plus the known oil pools which underlie the area.

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REMOTE VILLAGES AND FEDERAL INSTALLATIONS

REMOTE VILLAGES AND FEDERAL INSTALLATIONS

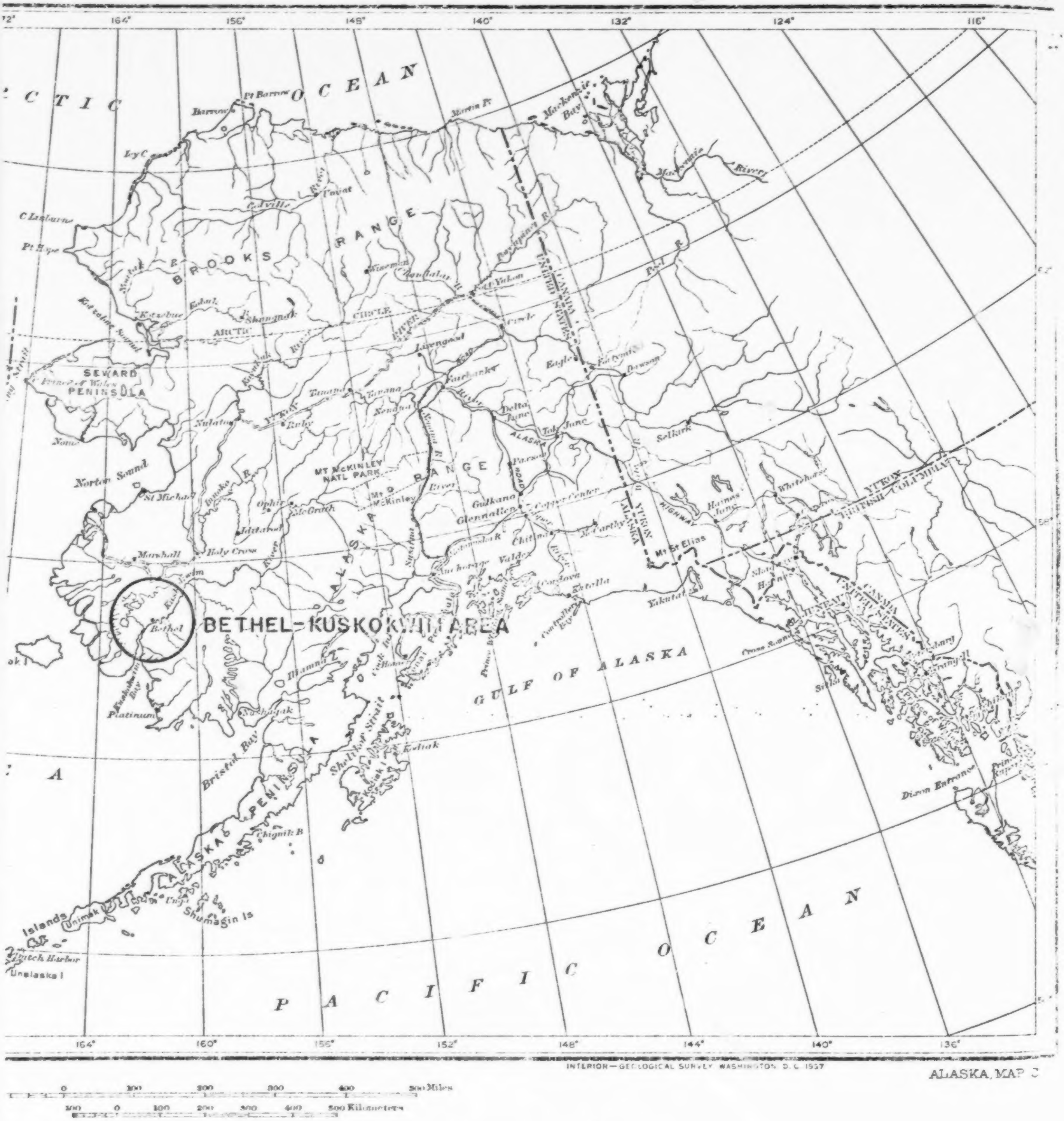
I. INTRODUCTION

The purpose of this summary is to evaluate and focus attention on the pollution problems at the native villages and federal installations located in remote areas of Alaska, and to recommend actions to abate the pollution.

The present pollution conditions at some of these villages and installations present serious health hazards to the population in the area, and in most instances are in violation of the Alaska Water Pollution Control Act and the Alaska Administrative Code. In addition to the State requirements, the Presidential Executive Order 11288 requires federal installations to provide adequate treatment for all liquid wastes.

To exemplify the waste disposal problems in these remote areas, the immediate vicinity area of Bethel on the lower Kuskokwim River has been singled out for the purpose of the report to help illustrate the sources of pollution for a "typical remote area of Alaska." The people living along the Lower Kuskokwim are greatly dependent on the river for their livelihood. Fish taken from the river constitute a large part of their diet and provide most of the food for their dog teams. Many of the population obtain a portion of their domestic water supply from the river, particularly in the form of ice during the winter months. Continued pollution of the river and poor sewage disposal practices could retard beneficial use of the river in the future, and definitely will increase the health hazard to the people living along its banks.

No field investigations or engineering studies were carried

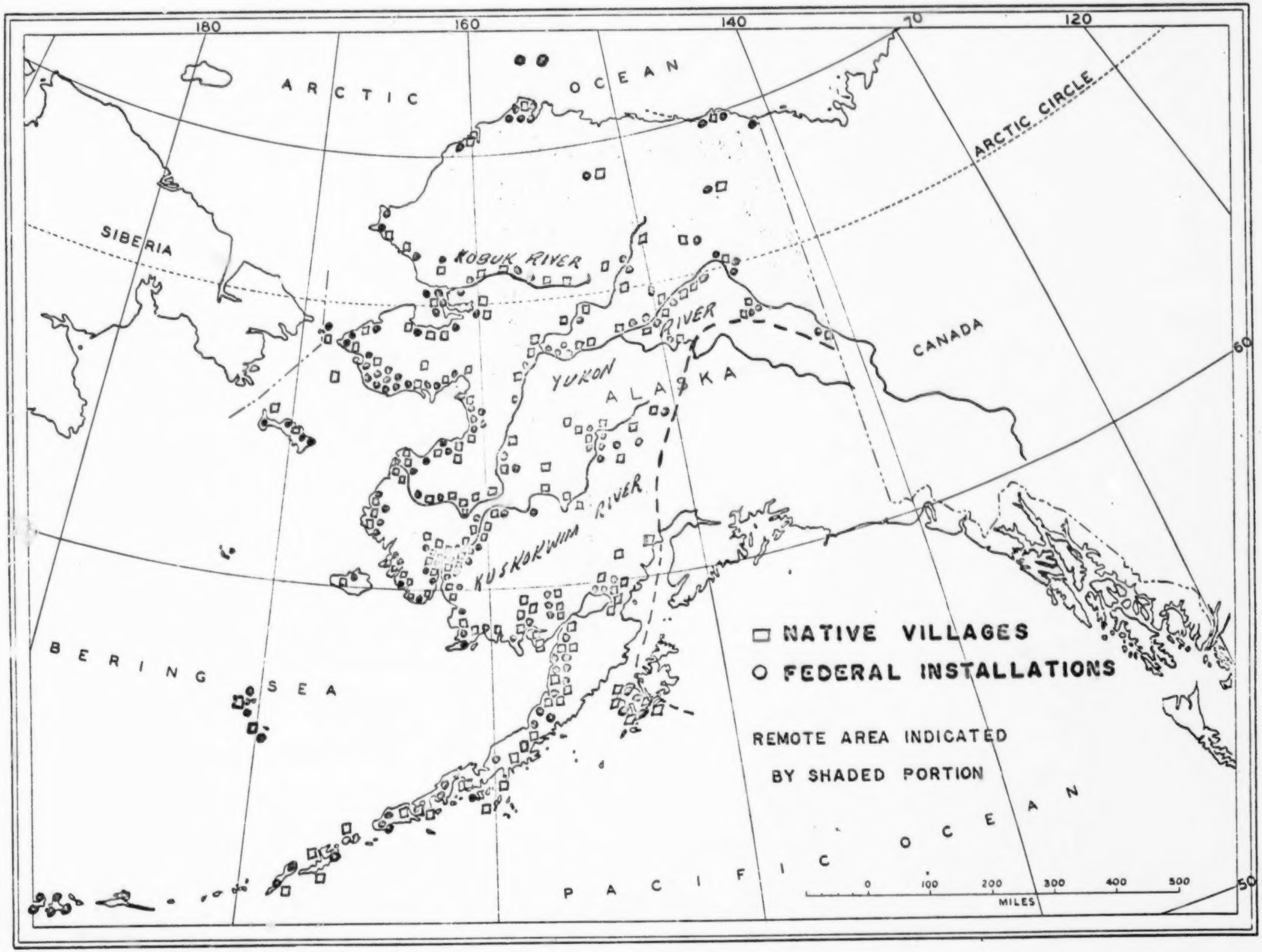

BETHEL-KUSKOKWIM AREA
Bethel
ARCTIC OCEAN
PACIFIC OCEAN
GULF OF ALASKA
BROOKS RANGE
ALASKA RANGE
ALASKA PENINSULA
SEWARD PENINSULA
MT McKINLEY NATL PARK
Pt Barrow
Barrow
Icy C
C Lisburne
Pt Hope
Kotzebue Sound
Kotzebue
Norton Sound
St Michael
Nome
Nulato
Ruby
Tanana
Fairbanks
Circle
Eagle
Dawson
Livengood
Nenana
Delta Junc
Tok Junc
Gulkana
Glennallen
Copper Center
Chitina
McCarthy
Valdez
Cordova
Katalla
Anchorage
Yakutat
Mt St Elias
Juneau
Sitka
Wrangell
Ketchikan
Whitehorse
Haines
Selkirk
Marshall
Holy Cross
Iditarod
Ophir
McGrath
Kuskokwim Bay
Platinum
Nushagak
Iliamna L
Bristol Bay
Shelikof Strait
Kodiak
Kodiak I
Chignik B
Unimak
Shumagin Is
Dutch Harbor
Unalaska I
Islands
Cross Sound
Dixon Entrance
Mackenzie Bay
Mackenzie River
Martin Pt
Yukon River
Colville
Umiat
Wiseman
Koyukuk
Porcupine R
Shungnak
ARCTIC CIRCLE
ALASKA HIGHWAY
YUKON
BRITISH COLUMBIA
CANADA
UNITED STATES
164°
160°
156°
152°
148°
144°
140°
136°
132°
124°
116°
0 100 200 300 400 500 Miles
100 0 100 200 300 400 500 Kilometers

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C. 1957

ALASKA, MAP C

U. S. GEOLOGICAL SURVEY, FEDERAL CENTER, DENVER, COLORADO OR WASHINGTON 25, D. C

11.3


180
160
140
70
120
60
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ARCTIC OCEAN
ARCTIC CIRCLE
SIBERIA
CANADA
KOBUK RIVER
YUKON RIVER
ALASKA
KUSKOKWIM RIVER
BERING SEA
PACIFIC OCEAN
□ NATIVE VILLAGES
○ FEDERAL INSTALLATIONS
REMOTE AREA INDICATED
BY SHADED PORTION
0
100
200
300
400
500
MILES

out for the preparation of this report. It was presumed that complete engineering design analysis will preclude physical implementation of the recommendations herein.

II. SUMMARY OF IMMEDIATE CONTROL NEEDS

Responsibility	Need	Relative Priority
A. Isolated native villages	Feasible and adequate primary treatment with chlorination	(A)
B. Bureau of Indian Affairs	Remote village schools, adequate secondary treatment or, preferably, utilize the village treatment facility	(A)
C. Department of Defense	Secondary treatment at remote military sites, as required under Executive Order 11288	(A)
D. Federal Aviation and other federal agencies	Secondary treatment at remote federal installations, as required under Executive Order 11288	(A)
E. Federal Water Pollution Control Administration	Development of feasible methods of treating sewage waste from remote villages and installations	(A)

F. Bethel-Lower Kuskokwim River Area

1. Waste Treatment

Responsibility	Need	Relative Priority
a. Town of Bethel	Collection system, primary treatment and chlorination	(1)
b. Native Villages (Akiak, Akiachak, Kwethluk, Napaiskak, Oscarville and Napakiak)	Centrally located lavatory facilities with discharge to an adequate treatment unit (sewage lagoon, package treatment unit, etc.)	(1)
c. Bureau of Indian Affairs Schools in above native villages	Connection to village sewage treatment facility	(1)

Responsibility	Need	Priority
d. Existing package sewage treatment units in Bethel	Extension of effluent lines to Bethel's collection system or to Kuskokwim River (with chlorination).	(2)
e. Salmon processing plants	Solids separation and connection to Bethel's collection system.	(1)
2. Other Pollution Control Practices		
a. Town of Bethel	Garbage collection system with land fill or other adequate solid waste disposal	(1)
b. Native villages and BIA school	Adequate solid waste disposal	(1)
c. Salmon processing plants	Adequate solid waste disposal	(1)

III. IMMEDIATE CONTROL NEEDS

The following actions are necessary to protect the use and quality of the watersheds affected and to protect the general health of the native and white population of the area.

1. Remote Native Villages

Because of the economic and climatic environmental problems associated with these isolated villages, the usual water carriage system serving individual houses for sewage waste disposal is not feasible in most villages. Therefore it will be necessary to develop adequate waste treatment facilities utilizing means that are relatively simple and feasible to construct and maintain. It will be the responsibility of the villages to provide operators for these systems and it will be the responsibility of the state and federal agencies concerned with waste disposal and water pollution to provide the necessary training for these operators to maintain the facilities.

2. BIA Schools

Adequate sewage treatment facilities (such as lagoons, package aeration units, etc.) should be constructed for each school. Wherever possible and feasible, the BIA school and the village should construct and utilize the same sewage treatment facilities. The maintenance and operation field crews of BIA should be fully trained and oriented on all the sewage treatment facilities located in their area. Frequent inspection trips should be made to the schools to maintain the treatment facilities in good operating condition.

3. Department of Defense, Federal Aviation Agency, and Other Federal Installations

Secondary treatment units should be installed at these remote sites to comply with the Presidential Executive Order 11288.

Each agency should have field crews especially oriented and trained in operating and maintaining sewage treatment facilities. Frequent inspections of all facilities should be made to keep the units in good operating condition.

4. Federal Water Pollution Control Administration

The Alaska Water Laboratory, through their research and development sections, should develop feasible methods of adequately treating the sewage waste from the isolated native villages and remote federal installations in Alaska. Special emphasis should be placed on the importance of developing treatment methods that the native economy and environment can support and operate.

The Alaska Water Laboratory should work closely with the federal agencies involved to make known their progress in developing treatment methods and should continue to provide technical assistance to the agencies on waste disposal problems.

5. Bethel - Lower Kuskokwim Area

a. Bethel

Direct water pollution to the river from domestic and industrial wastes is relatively small at this time. Most of the waste is currently discharged to the ground surface in the immediate vicinity of Bethel. High priority should be given to a water carriage collection system for Bethel, with a primary treatment plant discharging chlorinated effluent to the river. To serve those residences that would be unable to install adequate toilet facilities in their homes, heated community type lavatory facilities should be built along the collection system lines.

b. Native Villages

High priority should be given to construction of adequate and feasible sewage disposal methods for these villages to alleviate the health hazards associated with poor disposal practices. One recommended method would be to construct centrally located community lavatory facilities for each village with disposal to an oxidation lagoon or package treatment plant. If feasible, the lagoon or package plant should also be used by the BIA school facility. As insufficient information is available on sewage treatment facilities in these remote areas, research and developmental data are needed to obtain design criteria.

IV. COST OF IMMEDIATE NEEDS

With over 100 villages and some 200 federal installations in remote areas of Alaska requiring new or improved sewage treatment facilities it is only possible (without making a detailed study) to generalize the cost of obtaining adequate treatment. Because of the construction factors that must be considered when working in these remote areas (lack of adequate transportation, lack of trained local help, permafrost and tundra conditions, and severe climatological condition), a cost factor of 3 to 4 must be used. An estimated minimum of 11.5 million dollars would be required to meet the immediate control needs, broken down as follows: Native villages - 3 million; BIA Schools - 1.1 million (amount obtained from BIA); Military - 4.5 million; other federal agencies - 2.5 million. Of this total, the estimated cost for the Bethel area's pollution control needs is 2 million dollars.

V. RECENT PROGRESS IN POLLUTION CONTROL

Progress has been slow in abating pollution in the remote native villages. The Public Health Service under its PL-121 program has assisted the villages in constructing water supply wells, sewage disposal pits, and privies.

The Bureau of Indian Affairs has recently installed adequate treatment units in a few of their schools. However, due to a lack of trained operators and maintenance control the units do not always operate satisfactorily. The Federal Aviation Agency and Department of Defense are currently working on design criteria for sewage oxidation lagoons as one method of adequate treatment for their stations. A few extended aeration package units have recently been installed and are being evaluated.

Through the efforts of personnel of the Alaska Water Laboratory, the federal agencies involved have become more pollution control oriented in their programs.

VI. BACKGROUND

Adequate disposal of sewage wastes from remote and isolated native villages and federal installations in arctic regions of Alaska has long presented problems to the engineers and maintenance personnel responsible for designing and operating these systems. Severe winters with temperatures reaching the -40° to -60° F. range will freeze sewage when sewer pipes are located close to the surface. Burying the lines below the seasonal frost level offers little protection against freezing, since the permafrost zone extends upward and meets the seasonal frost depth in many arctic regions. The soil temperatures in the upper layers of permafrost are generally between 22° and 32° F.

1. Native Villages

The locations of most of the villages create major problems in providing feasible and satisfactory methods of treating sewage wastes. Of approximately 200 native villages in Alaska, over 100 are located in the flat marshy arctic and subarctic tundra country of western and northern Alaska. Hundreds of small shallow tundra lakes, perched on top of permafrost that may be hundreds of feet thick, cover the landscape. Although these tundra Eskimo and Indian villages are generally situated along the banks of lakes or meandering rivers with water all around, most villages are without an adequate potable water supply. Because of their isolated locations in the tundra, no road systems, electrical transmission lines, telephone lines, etc., serve the villages. All materials for constructing waste treatment facilities would have to be brought in on the ocean-going cargo ships that land once or twice a year (summer only) at the area trade centers (Bethel, Nome, Barrow, etc.) and then flown by small bush planes to the individual villages.

The economic development of the native villages has been slow. The 1960 information from nine election districts covering native villages in these remote areas mentioned above showed: 83% of the homes without a public water system or private well; and 86% without toilet facilities.[1] Most of the families still "live off the land," relying on fishing, hunting and trapping to provide most of their food and clothing.

Lack of electricity in the villages has restricted the type of water and waste facilities constructed. The toilet facility for the majority of the Eskimo population in the villages is the household "honeybucket".[2] The usual waste disposal practice in these villages is to dump the "honeybuckets" into some type of waste disposal pit. The accepted method of a few years ago - dumping the "honeybucket" contents in the river or on the ground around the house - is, fortunately, generally being discontinued.

2. BIA Schools

The Bureau of Indian Affairs provides elementary education to the native children in these remote villages. The teachers, generally a husband-wife team, have quarters in or adjacent to the school building. These school facilities are located in the villages and thus are subject to most of the water supply and waste disposal problems of the natives. However, the schools do have their own power supply and thus are better equipped to overcome some of these problems. Most of the school facilities have been provided with deep wells through the permafrost for a water supply. At some of the schools sewage treatment facilities have been installed to replace the older honeybucket system. These consist of septic tanks, small package plants, lagoons, etc. However, because of the severe climatic and environmental factors in these areas, these facilities need trained maintenance personnel to service the treatment units. The teachers, generally, are not mechanically oriented enough to keep the units in good serviceable condition.

3. Military Sites

The Department of Defense has installed a network of radar and missile sites throughout the State of Alaska. Because of the nature of these sites they were built at locations important for military strategy, and little, if any, priority was given to the availability of water and adaptability for sewage disposal. Consequently, water must be piped or carried great distances to many of these sites, often located on top of one of the highest hills in the area. In the past, the problem of disposing sewage waste was usually met by discharging the effluent from a septic tank over the side of the hill. The personnel stationed at these remote sites are generally on one or two year contracts and are not familiar with the waste treatment facilities or the problems associated with operating the units under the adverse conditions of arctic and subarctic Alaska.

4. Other Federal Installations

There are many other federal agencies that have installations in the remote areas of Alaska. The Federal Aviation Agency, Public Health Service, Weather Bureau and Fish and Wildlife Service, among others, are actively engaged in field activities in these areas.

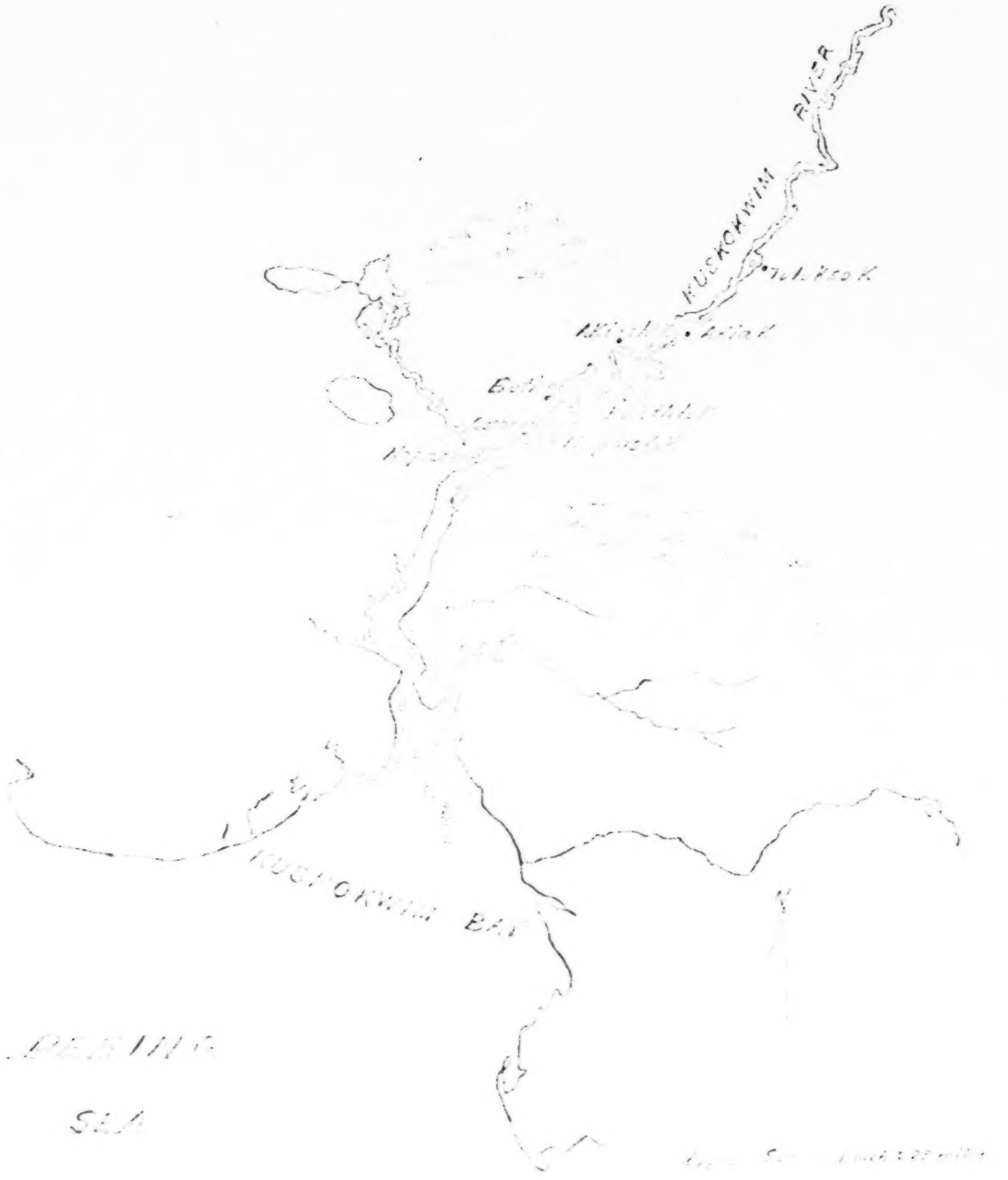
In general, these agencies face most of the same problems concerning sewage waste disposal that were mentioned earlier under native villages, BIA and military installations.

5. Bethel - Lower Kuskokwim Area

Bethel, located approximately 100 miles from the mouth of the Kuskokwim, is at the head of tidal fluctuations and is the terminus for ocean-going vessel transportation. It is the "hub" of western Alaska's trading activity and is the "modern city" of the area, with dirt streets and cars. None of the other villages have such modern conveniences; only an occasional wooden plank sidewalk. River boat (summer) and dog team (winter) are the main means of transportation for the natives, with the Kuskokwim River serving as a highway. For the purpose of this report, the Lower Kuskokwim area encompasses the populated fifty mile stretch of river from Akiak to Napakiak. (See figure 1 for vicinity map.) Half of the 2500 (approximately) people in this area live in Bethel (population of 1300) with some 200 in Akiak, 225 in Akiachak, 325 in Kwethluk, 50 in Oscarville, 150 in Napaiskak, and 200 in Napakiak.[3] The only white population in the six villages is generally the BIA schoolteachers.

The community of Bethel is served by a partially subsidized "honeybucket" collection service which made somewhat regular house collections and hauls to a designated disposal area adjacent to Brown's Slough and within a mile of Bethel. It is probable that some part of the sewage liquid drains and percolates into Brown's Slough which flows through Bethel and empties into the Kuskokwim River.

Two commercial establishments in Bethel have river outfalls from primary sedimentation units of questionable performance.


KUSKOKWIM RIVER
Tuluksak
Akiak
Bethel
KUSKOKWIM BAY
BERING SEA

Reproduced from best available copy.

Fig. 1

[illegible]

The effluent from three small package treatment units in Bethel, State Armory-gymnasium-school complex, Alaska Communication System telephone building, and Nicholson's water treatment plant drain to the surface muskeg in town. The Public Health Service Hospital, located adjacent to Bethel, has a primary treatment plant which also discharges to the ground surface. Fish viscera waste are dumped directly into the river from two small seasonal salmon processing plants.[4]

The economic structure of the villages is low, with a majority of the families "living off the land". A survey of 10 villages, selected at random in the greater Bethel area (100 mile radius) showed only 2% of the population has permanent employment.[5]

The climate of this area is considered severe with the winters cold (down to -50° F.) and windy (mean hourly windspeed of 10.3 m.p.h.).[6] The lakes and rivers are frozen for more than half the year. The summers are cool and rainy with the temperature seldom reaching 70° F. Severe premafrost conditions exist at Bethel and five of the native villages, (Kwethluk is located on an old river channel of the Kuskokwim and no permafrost exists). Permafrost depths up to 400 feet have been encountered in the vicinity of Bethel, with depths of 50 to 100 feet common.

The Kuskokwim River drains the western side of the high Alaska Range and thus is heavily laden with glacial silt. There are no flood control dams on the river to slow the rampaging Kuskokwim at spring break-up. Consequently, the villages along its banks are flooded to some extent almost every year. Often an entire village will be flooded with several feet of muddy water. While these floods "clean out" the garbage and sewage accumulations, they also deposit layers of mud and debris in the villages.

Based on the above elements of the area, design, construction and maintenance of public utilities in Bethel and adjacent villages become major problems.

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